PUBLIC WORKS

July
1960

CITY, COUNTY AND STATE

RESEARCH IN SANITARY ENGINEERING
Special Section Reports
Recent Developments
pages 85-109

Accidents Reduced by BRIDGE LIGHTING PROGRAM
page 115

Residential STREET PAVING By Special Assessment
page 117

New Rainfall INTENSITY-DURATION CURVES
page 120

Program for CITY SURVEYING in St. Paul
page 123

PAGE 5 LISTS ALL ARTICLES IN THIS ISSUE

Dr. Daniel A. Okun is Head of the Department of Sanitary Engineering at the University of North Carolina. During the coming year he will engage in study and research in Europe. See page 18.

GALION®
Vibratory Compaction... UNITS

With the GALION 3-WHEEL ROLLER VIBRATORY COMPACTOR combination, you not only attain specified densities of granular materials, but you also can achieve effective compaction of the many soils which respond best to a static weight roller. In addition, the 3-Wheel Roller can be used for the compaction of finish surface materials. This multi-purpose usage multiplies the profit possibilities on your roller investment.

●

With the GALION Model 503 GRADER-VIBRATORY COMPACTOR combination it is possible to spread, level, and compact the material—all in ONE operation or separately as the situation may demand. The vibrating unit is raised hydraulically for speedy travel on, to and from the job. The profit possibilities of this combination are not limited to one function. Vibrating Compactor unit is easily removed to permit other grader operations such as ditching, blading, windrowing, etc.

With the GALION Grader or Roller and Vibratory Compactor combination you SAVE—on equipment cost, labor costs, operating costs and overhead costs.

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ELECTRIC VIBRATORY COMPACTOR FEATURES

- Delivers up to 4200 three-ton, deep-penetrating compacting blows per minute.
- Vibratory Compactor can be operated with Roller or Grader traveling forward or reverse.
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- Roller and Grader are protected against vibration of the compactors which FLOAT on the surface.
- Power unit (engine and generator) for compactor can be used as an emergency lighting plant or for the operation of small power tools.
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Street_____ City_____ State_____

"from Chicago"

A development of 25 years of sludge pumping experience...

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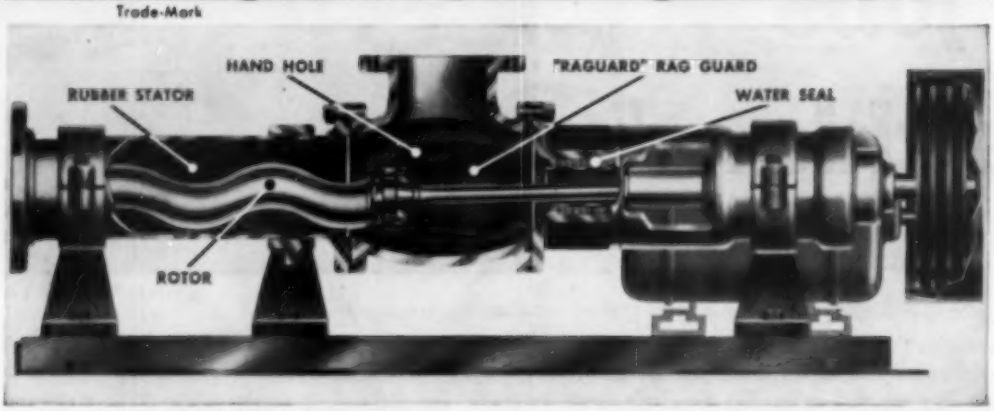

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BETTER...here's why:

- Rotary, positive displacement pumping
- "RAGUARD"—"Chicago's" special shaft rag guard
- Low Speed operation
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- Durometer 60 hardness BUNA-N RUBBER STATOR
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For:

- **Primary sludge pumping**
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- **Digester sludge recirculation**
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Sizes: **For pumping sludges from 75 G.P.M. to 400 G.P.M. . . . at a 120' head**

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Report from Pikes Peak, Colorado

"They've got to be good for jobs like this..."

"Dozing rock at high altitudes is a mighty tough job," says Al Mason, Field Superintendent for the Water Division, City of Colorado Springs, Colorado. But the city's new Cat D7D Tractor takes the work in stride, proves it more than meets the test. Here it demonstrates power and stamina as it speeds development of a municipal reservoir system on the northern slopes of Pikes Peak. The engine's exhaust gas driven turbocharger packs plenty of air into the cylinders so that even in the rarefied atmosphere the 140 HP D339 Diesel Engine breathes easily and efficiency stays high. "The improvements on the new D7 make it a real producer," Al Mason said. And an average of 1¾ minutes per 300 foot cycle proves him right.

On the Pikes Peak job, the new D7 builds service roads and clears the right-of-way for pipelines. Although the work often calls for clearing 20 to 25 foot stretches of blasted rock, maintenance on the D7 is no more than routine. The exclusive Caterpillar oil clutch, for example, generally needs only adjustment when other clutches need replacing. Other time-saving, cost-saving features are the tractor's service-free lifetime lubricated track rollers, hydraulic track adjusters which make it easy to keep track in perfect alignment, a long-lived pressure-lubricated transmission and a dry-type air cleaner that takes less than five minutes a day to service. These are just a few of the reasons the D7D offers more value for the taxpayer's dollar than any other machine of its size.

See your Caterpillar Dealer for the facts and figures. He'll show you how the D7 can earn its keep in high production, tell you why its top-quality construction and low maintenance mean sizeable yearly savings.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

FEATURES OF THE NEW D7

TURBOCHARGED ENGINE with 80 per cent more lugging ability for greater production.

LIFETIME LUBRICATED TRACK ROLLERS with patented floating ring seals eliminate maintenance time and costs – they never need servicing and new load carrying design extends roller life.

PRESSURE-LUBRICATED POWER TRAIN insures complete circulation of oil to transmission, bevel gear and pinion. Added strength in components takes the increased power with room to spare, keeps down time to an absolute minimum.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

THE NEW D7
FIRST IN QUALITY
LOWEST IN FINAL COST

JULY, 1960 • Volume 91, Number 7

SELECTED REPORTS ON RESEARCH IN SANITARY ENGINEERING

Research Institutes—Past, Present and Future 85
GEORGE R. HERBERT

Occurrence and Behavior of Natural and Radioactive Strontium in Water 88
M. W. SKOUGSTAD AND F. B. BARKER

Research in Water Supply Prediction 90
EDWARD H. WISER

Corrosion Control in Potable Water Systems 92
ROLF ELIASSEN AND ROLF T. SKRINDE

Sodium Chloride Uptake by Algae 95
GILBERT V. LEVIN

Pesticides and Lake Rehabilitation 97
ROBERT O. SYLVESTER AND RICHARD H. BOGAN

Toxicity of Selected Ions on Activated Sludge Treatment 98
E. Q. MOULTON AND GEORGE P. HANNA, JR.

Separation of Solids in the Anaerobic Contact Process 100
A. J. STEFFEN AND MILES BEDKER

Factors Inhibitory to Sludge Digestion 103
JAY S. GRUMBLING AND CLAIR N. SAWYER

Volatile Acid Formation During Sludge Digestion 105
JAMES E. ETZEL AND FREDERICK G. POHLAND

Irradiation Sterilization of Diets for Germ-Free Animals 108
JOHN L. S. HICKEY AND DONALD L. SNOW

Study of Hazards in Disposing of Insecticide Containers at a City Landfill 110
Safeguards that permitted the disposal of fiber and metal drums that had contained toxic insecticides without harm to the bulldozer operator.
G. ALLEN MAIL, WILLIAM V. HARTWELL, GEORGE R. HAYES JR., AND ARNOLD J. FUNCKES

Subsurface Bedrock Along Highway Route Mapped by Seismograph 111
Case history of the use of a miniature seismograph for highway route survey in a rough, heavily wooded area. W. R. LIEBENOW

Water Diversion and Flood Problems Require Ingenious Control 113
Gaging stations, telemetering and a system of Bascule gates accomplish mandatory diversion of flow plus flood protection. H. A. MAYO, SR.

Accidents Reduced by Bridge Lighting Program 115
Remarkable accident reduction rate is a dividend for Baltimore's lighting program on motor vehicle bridges. WILLIAM F. HALLSTEAD

Residential Street Paving by Special Assessment 117
Peoria's program for soil-cement construction of residential streets.
RICHARD R. HINES AND B. J. ADKINS

City of Oakland Develops New Rainfall Intensity-Duration Curves 120
Substantial savings in the annual cost of drainage structures result from a study of rainfall records.
DONALD M. WINTON

Surveying Keeps Pace with St. Paul's Growth 123
Current well-organized program still benefits from careful establishment of bench marks placed 60 years ago. EDWARD L. O'CONNOR

Stumped by Your Stump Problem? 125
How the costly problem of stump removal was solved by mechanical equipment. R. H. VAN DEUSEN

Bridge Widening Program Gets Public Praise 126
In the past five years, 1,030 bridges have been widened or replaced under a program of the Indiana State Highway Department. CHARLES D. MILLER

Reservoir Roofs Protect Water Supply 142

Equipment Procurement and Replacement 144

Automatically Controlled Diatomite Filter Plant 146

Attractive Municipal Garage 158

Heavy Machines for Heavy Snow 178

Clearwell Level Control 180

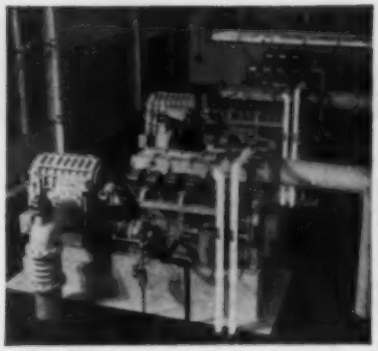
PUBLIC WORKS DIGESTS

Water Works 136

Highways and Airports 148

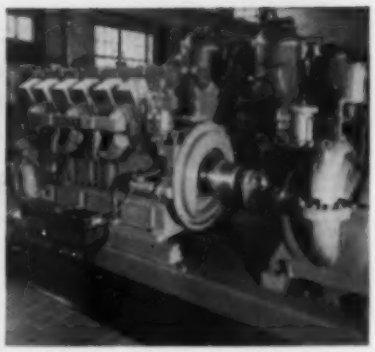
Sewerage and Refuse 160

Industrial Wastes 172



Four Climax sewage gas engines powering blowers and pumps in a Michigan sewage treatment plant.

Three Climax engines, one Model K-67, and two V-85's driving vertical sewage pumps through right angle gears.



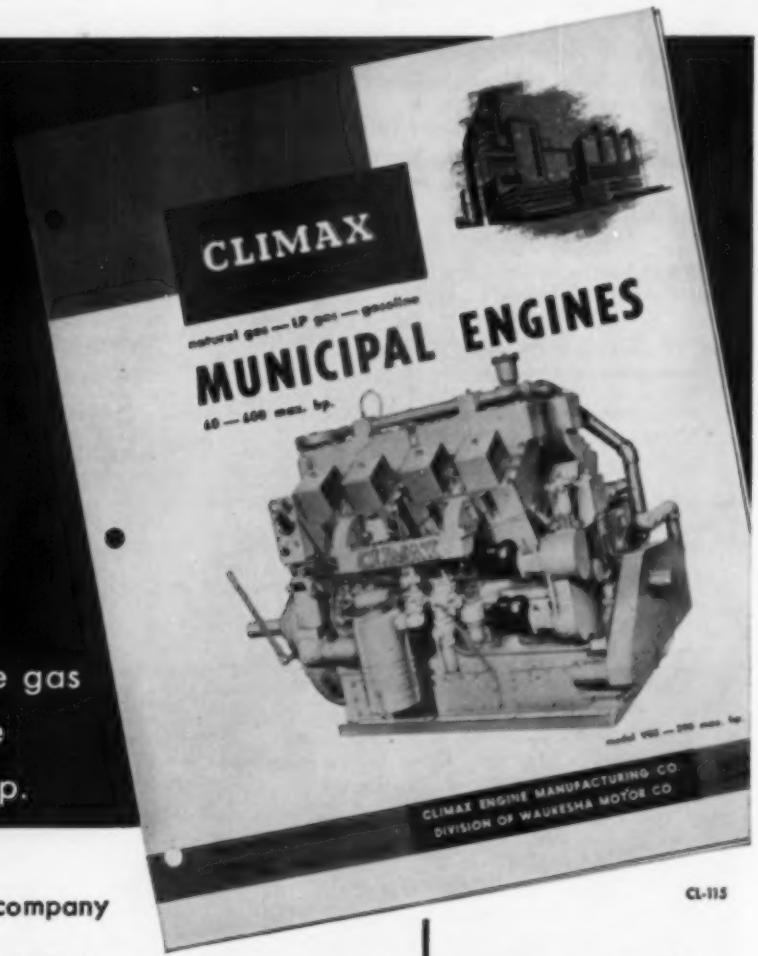
Model V-12 Climax engine in high capacity centrifugal pump service in a city water plant.

CLIMAX POWER

for dependable municipal plant service

Climax engines provide excellent low cost power for sewage and water treatment plants. These rugged, simply designed engines are engineered to give quick acceleration, withstand overloading, and perform longer with less maintenance.

natural or sewage gas
LP gas • gasoline
60 to 600 max. hp.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natural gas — LP gas — gasoline
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Research on Public Works Problems

THERE HAS never been enough research in the public works field but of late there have been stirrings that promise more activity. Some important studies now under way will be described in our annual research issue which will appear in July. Three years ago, PUBLIC WORKS initiated, as an annual event, an issue devoted largely to pertinent research. The purpose was three-fold: To encourage more research; to bring to our readers information on developments from work being done; and to provide a degree of recognition for research workers. The forthcoming issue is a further step toward those still needed and desirable objectives. Knowing what is going on in this field is the first step toward recognition and support.

Highway Sales Engineers

THERE HAS been much discussion at highway conferences around the nation about the need for "selling" the current highway program to the public and to our legislators. Industry has made significant contributions toward this objective through the production of films and educat onal advertising in television, radio and newspapers.

The highway engineering profession, however, has not capitalized on the best sales force it can ever obtain—the men practicing the profession today. Within their own associations and conferences, they are a generally well-spoken and capable group, explaining their problems, projecting their plans, revealing their objectives. But the public seldom sees this side of the highway engineer. He is usually pictured in the terse prose of the newspaper reporter—if referred to as a person at all. His engineering competency is oftentimes judged by a few brief news quotes—sometimes taken out of context—and almost always bearing on a controversial design, financing or location problem commanding the current concern of the reader.

No product, industry or profession can create an accurate and favorable public image in such a fashion. To know the nation's highway engineers today would be to know that this most complex, costly and necessary facet of our transportation system is in good hands. But how can this confidence be transmitted to the public? There are two ways we would like to suggest.

First, every highway engineer should dedicate himself to the selling of his "product" with the same enthusiasm and due pride that he is approached by sales representatives of industry. The highway engineer's "customers"—the public—are his neighbors, his fellow club and church members, his community, state and national officials. Opportunities to discuss local and national highway programs with these "customers" should be readily accepted. Loyalty to his organization and pride in its accomplishments should be demonstrated by word and action.

Second, a high standard of maintenance on those modern highways now completed will prove to be an excellent advertisement of their worth and desirability to the public. Superior design standards and quality construction are soon lost to the eye of the traveling public if maintenance standards do not follow suit. No sound program can direct billions of dollars to new construction without an equitable provision for maintaining and protecting this investment—and concurrently presenting it to the user in its most effective light.

The next twelve months may well be a period of major decisions in our national highway program. Our salesmanship may provide the right decisions.

Films In Brief

BEGINNING IN this issue, PUBLIC WORKS offers a new reader service in the form of a listing, to be carried as a regular feature, identifying current moving picture films of interest to engineers, administrators and supervisors engaged in public works. It is hoped that this ready reference will be of value to you in planning training sessions, conference programs, service club and community presentations, equipment and operations studies and a wide variety of other applications. Industry, professional associations and many public agencies have devoted much time, talent and money to foster better understanding of our complex public works programs through the production of these films. Your interest in giving them wide viewing by appropriate audiences will be welcomed.

If your organization has a film suitable for inclusion in Films in Brief, send us the necessary information and we'll be glad to include it. Now, pull the shades so we can get that projector started. . . .

DON'T BE FOOLED BY INITIAL PIPE COSTS...

Certain factors concerning the type of pipe to be used for a proposed water or gas project must be examined carefully:

First
—how much does the pipe cost, compared to other types?

Second
—how often will it require repair?

Third
—how long before it has to be replaced?

After all, how much money do you really save if you buy the cheapest pipe . . . then have to repair it frequently . . . and *then* have to replace it within a decade or two?

You save with cast iron pipe

Sometimes the first cost of jobs where cast iron pipe is specified, is higher than similar projects using cheaper pipe. Yet, in the long run, cast iron pipe costs *less!* Here's why:

- Cast iron pipe rarely requires repairs. Its rugged construction, corrosion-resistant qualities and bottle-tight rubber-ring joints will withstand the most severe pressures. Once an investment is made in cast iron pipe, it is usually your first and last cost because of the absence of maintenance or repairs.

- Cast iron pipe is built to *last*—98 American cities will testify to that. They've had cast iron pipe installations in constant use for over a century! In fact, in Versailles, France, they're still using cast iron pipe water mains that were laid in 1664! Once cast iron pipe is in the ground, it stays there!

Don't be fooled by "low-cost" pipe. Insist on the pipe that will actually save you money over a period of years . . .

In Nebraska—Here a section of cast iron pipe is being relocated. Twenty-five years old, the pipe is still in excellent condition—has never required major repair . . . or replacement.

Rely on CAST IRON PIPE

In Indiana (above)—"All-weather" cast iron pipe is quickly installed despite wet trench conditions. Slip-on joints were easily assembled, with one workman using a crowbar.

In Kansas (above)—36" cast iron water main. Another part of this main was floated out of its trench by a heavy downpour. Later a 150 psi water test revealed no leaks in the slip-on joints!

In Pennsylvania (below)—This 16" cast iron pipe is being installed as fast as the trench hoe can prepare the trench.

Handy lengths and slip-on joints make cast iron pipe easy to handle, even in crowded neighborhood sectors; require less labor.

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

Cast Iron Pipe Research Association,
Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois

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program to provide

General Electric introduces *PREFERRED LIGHTING* —a new program offering *exceptional customer service* on outdoor-lighting systems.

With *PREFERRED LIGHTING* you get a full selection of fast-moving equipment—equipment most preferred on a national basis as evidenced by present purchases—plus application analyses combining the latest lighting trends and the most economical and effective ways to do specific lighting tasks.

In addition, *PREFERRED LIGHTING* makes possible exceptionally fast delivery of street-lighting systems. On products of our own manufacture, equipment is usually in your hands in one to three days after receipt of your order.

General Electric offers you the widest variety of equipment necessary to meet your general and special lighting needs. But, your optimum use of the "customer-selected" *PREFERRED LIGHTING* systems will bring the immediate benefits of superior product performance . . . one-to-three-day delivery . . . easy selection, ordering, and application . . . all adding up to top value for your lighting dollar.

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When you select G-E *PREFERRED LIGHTING* equipment you'll know you are buying the type of equipment which has proved most popular with customers all across the country—*preferred* by a majority of customers for performing the same lighting tasks

PROVED PERFORMANCE results because General Electric *PREFERRED LIGHTING* represents customers' choices of the best in filament, mercury, and fluorescent lighting. Only 148 catalog numbers (5000 are available) meet 95% of all roadway lighting needs.

QUICK DELIVERY—one-to-three-day delivery is maximum for most General Electric *PREFERRED LIGHTING* equipment including pole anchor rods and base templates. Poles can be ordered for one- to four-week shipment, allowing time for curing concrete bases prior to installation.

LIGHTING... a new General Electric more light per dollar on America's roadways

you are interested in solving. These systems have met the test of customer evaluation in terms of cost of light, and over-all operating and maintenance economy ... *your best guarantee of a modern lighting installation.*

ONE-TO-THREE-DAY DELIVERY

With *PREFERRED LIGHTING*, you can reduce your inventory investment. Much of your warehousing and inventory expense is borne by General Electric.

A simplified product line, pre-designed lighting systems and layouts, and the ability to order from a single source mean you can order most lighting equipment by phone. What's more, in most cases you can expect to have your equipment at the installation site within one to three days of your order!

SIMPLIFIED SELECTION AND APPLICATION

General Electric's new *PREFERRED LIGHTING* Designer's and Buyer's Guide is a compilation of all pertinent data you need to select, order, and apply complete lighting systems or components.

By following "customer-approved" *PREFERRED LIGHTING* recommendations, you save the time and expense of individual lighting layouts and calculations. Factors such as distribution patterns, spacings, mounting heights, and maintenance factors are already worked out in advance. Just select the type of lamp and the footcandle level you desire.

***PREFERRED LIGHTING* IS AVAILABLE NOW**

Get your *PREFERRED LIGHTING* Designer's and Buyer's Guide, today! Use it as a basis for a thorough evaluation of your present buying practices, in comparison with the benefits offered by General Electric's *PREFERRED LIGHTING* approach. Your G-E Apparatus Sales Engineer or Agent will be happy to help. General Electric Company, Outdoor Lighting Dept., Hendersonville, N. C.

Progress Is Our Most Important Product

GENERAL ELECTRIC

EASY APPLICATION saves you the time and expense of designing individual layouts, and considering distribution patterns, spacing, mounting heights, and maintenance factors. Selection of *PREFERRED LIGHTING* equipment is a simple matter of deciding on source and footcandle level.

New PREFERRED LIGHTING Guide

General Electric Company
Section B460-02
Schenectady 5, New York

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Company _____

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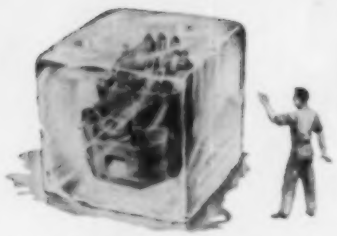
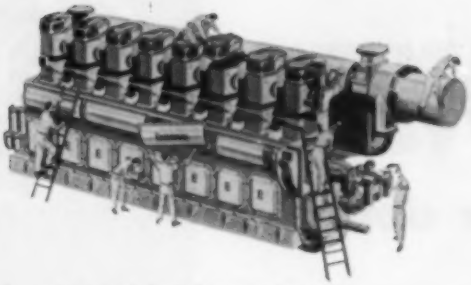
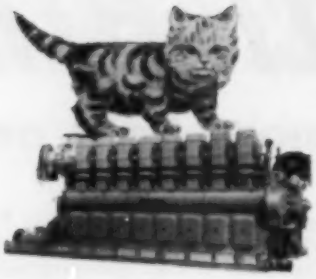
City _____ State _____



A really efficient cooling system? No "hot spots" with ENTERPRISE –it never runs too hot or too cold!



Accessibility? It's easy to get to *all* the parts!



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Mr. Diesel Engine Buyer:

What Do You Look For In A Diesel?

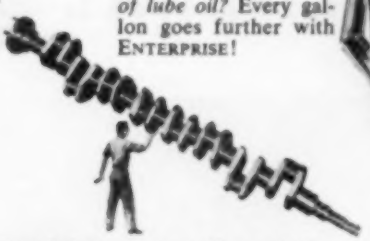
Sustained, continuous and economical performance ...hour after hour, year in and year out!

This is what you want in your next diesel engine. And this is what you will *get* with dependable ENTERPRISE Diesels.

Some of the key features that combine to make ENTERPRISE your best buy in heavy-duty diesels are shown here. There are many others you'll want to know about – up to the minute features of design, materials and construction that are the result of 35 years experience in power research and diesel engine building... features that contribute to the most efficient and reliable power available at a fraction of the cost you'd expect.

Your own comparison will prove that there is no finer diesel. Write for complete information on ENTERPRISE... *the choice of power experts.* Units from 75 to 2700 hp.

More hours per gallon of lube oil? Every gallon goes further with ENTERPRISE!



True balance for smooth running? ENTERPRISE takes the "jitters" out of diesel operation!

Top service... where and when you want it? ENTERPRISE customers get fast service... and parts within hours!

ENTERPRISE Diesels

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18th & Florida Streets, San Francisco 10, Calif. • National and worldwide sales and service.

Fast, water-tight, acid-resistant coupling for **RECESSED** concrete pipe with . . .

TYLOX® "CR" *flexible* GASKETS

TYLOX "CR" Gaskets are for tongue and groove, or bell and spigot concrete pipe of all sizes having a recess on the pipe tongue, or spigot, in which the joint medium is seated. When planning waste disposal lines using recessed concrete pipe, also plan on TYLOX "CR" pipe joints, and be assured of these performance advantages:

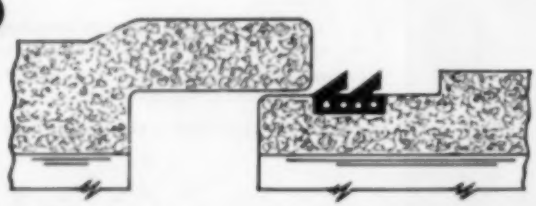
WON'T ROLL OR TWIST — the wide, flat design of the Gasket, plus support provided on both sides by walls of the recess, prevents Gasket from being rolled or twisted out of true position during coupling operations.

COUPLES IN SECONDS — Merely shoving gasketed pipe home into the line completes the joint . . . water in the trench does not delay the work . . . backfill may be applied immediately.

WON'T LEAK — Multiple sealing fins of the Gasket compress into the specially designed base to form a solid "pack" of rubber which prevents water from leaking in or out of the joint (see figs. 1 and 2). Root and sediment problems are eliminated . . . infiltration overloads on treatment plants are prevented.

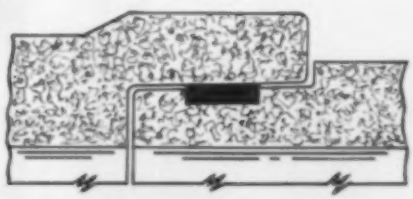
RESISTS ACID ATTACK — TYLOX "CR" Gaskets are made of rubber or neoprene specially compounded for immunity to sewerage and industrial wastes, acids or alkalies. Under ground and under compression, they outlast the pipe itself.

1



TYLOX "CR" Gasket properly positioned on recessed concrete pipe.

2



TYLOX "CR" Gasket under full compression

WRITE FOR DATA BROCHURE

Fully illustrated engineering information and installation instructions. See why there are more TYLOX Gaskets specified for low head service than all other types of Gaskets combined. Specify TYLOX "CR" Gaskets for your next recessed concrete pipe project.

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City fathers like Waterspheres because each structure is backed by CB&I's seven decades of craftsmanship in steel.

Engineers like Waterspheres because only a minimum of ground area is required for foundations . . . and plates can be pickled and painted before shipment.

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Kids like Waterspheres . . . best of all. Why? Who knows? But did you ever pass one on the highway without a comment from the back seat? (*Parents like them because they're safe . . . kids can't climb Waterspheres.*)

. . . because they satisfy so many people

The final selection of water storage facilities is often the responsibility of a small group. Vast numbers of the population are affected, however. And . . . if this choice is not suitable to the majority of citizens, loud protests are certain to be heard.

This is why more and more communities rely on CB&I Waterspheres (and Waterspheroids*) to solve their water storage problems. You just can't miss them. They landmark municipal progress . . . combining beauty and prestige with efficient water system planning. Yes . . . you see so many Waterspheres . . . because they satisfy so many people.

***WATERSPHEROIDS . .** are big brothers to Waterspheres. They differ only in shape and size. Watersphere capacities range from 25,000 to 250,000 gallons. Waterspheroids are available in capacities up to 500,000 gallons.

A brochure containing details and specifications on both the Watersphere and Waterspheroid is available. Ask for Catalog A-40.

CHICAGO BRIDGE & IRON COMPANY

CBI

332 SOUTH MICHIGAN AVENUE
CHICAGO 4, ILLINOIS

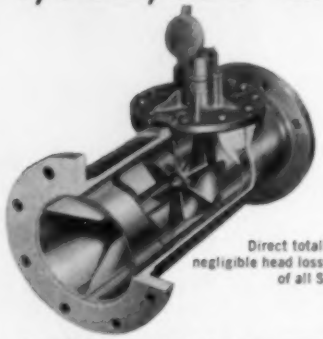
OFFICES AND SUBSIDIARIES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

providing totalization
of varied flows from

30 GPM

to

1,500,000 GPM



Direct totalization and accuracy with negligible head loss are outstanding features of all Sparling Main-line meters.

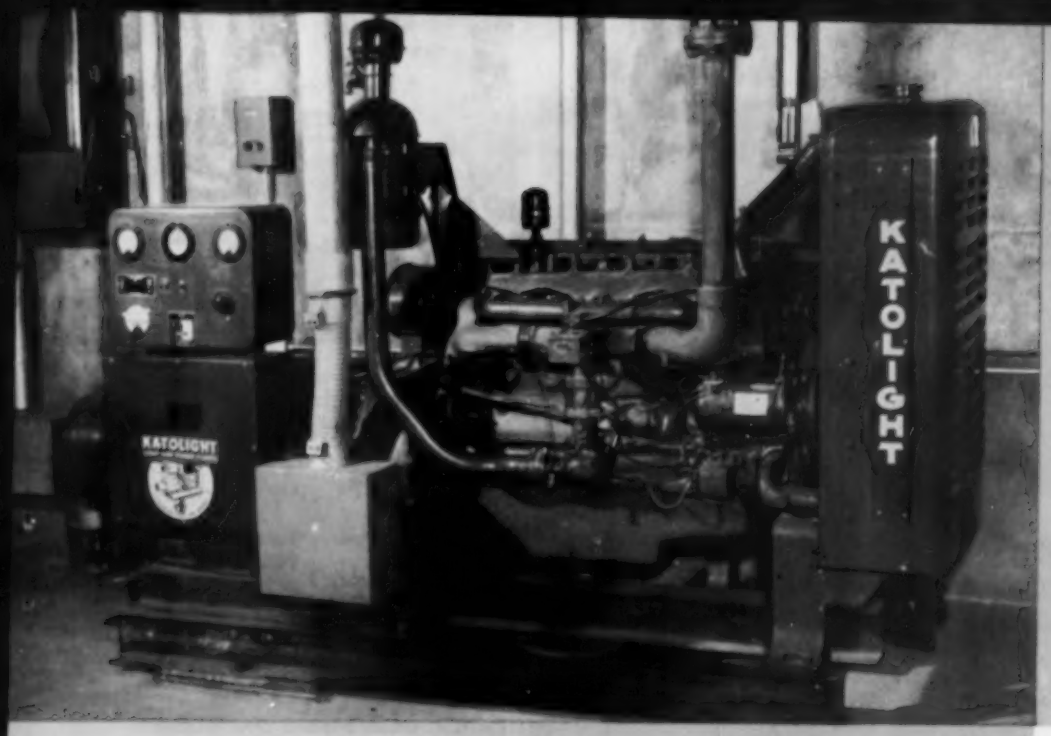
More than 30,000 Sparling Main-line meter installations are serving American towns and cities every day, with thousands more in use throughout 29 foreign countries. Applications vary from single 2-inch meters for minimal requirements to multiple 19-foot installations that handle flows in excess of 1½ million gallons per minute... universal proof that wherever, or whatever, the need for Main-line metering you can specify, and depend on, Sparling.

Sparling is the pioneer propeller meter. For nearly half a century Sparling equipment has been serving the waterworks field with high performance meters, recording instruments, and controls. Let Sparling serve you, too. *Write for Catalog #315, or call your local Sparling field engineer.*

SPARLING
WATER CONTROL EQUIPMENT

HERSEY-SPARLING
METER COMPANY
Sparling Equipment: **EL MONTE, CALIF.**
225 North Temple City Blvd.

Branches: Atlanta · Chicago · Cleveland · Dallas · Denver · Kansas City, Mo. · Roselle, N. J. · San Francisco · Seattle • United Kingdom Affiliate: TYLORS OF LONDON LTD.



"We get power from this emergency standby unit so fast the alarm section doesn't even know the regular power has been cut!"

—M. Seward, Superintendent of Memphis Communications Control Center Building

CITY'S NERVE CENTER GUARDED by International Power

The radio and communications center of the Memphis Fire and Police Departments is certain of full transmission and receiving power at all times. Successful operation at this vital point requires absolute reliability and instant resumption of power supply. Memphis gets both from their standby International U-450 engine and 50-kw Katolight generating plant. The city's half million citizens are assured of fire and police protection through any emergency.

Memphis officials depend on International power for other jobs, too. The 10,000 seat civic auditorium, operated by the City of Memphis and Shelby County, has another International U-450 on standby duty for lighting all ramps and exits in event of electric power failure. Both units burn natural gas—the least expensive fuel in this instance—to give the city additional savings.

The wide selection of low-cost International power extends this type of efficient performance to every municipal application. When you approve International engines for pumps, generators, construction and maintenance machinery, or auxiliary units, you get more years of dependable performance for fewer tax dollars. A wide variety of accessory equipment lets you further match the power to the job.

There are 35 engines in the International line—16.8 to 385 max. hp—gasoline, LP gas, natural gas or diesel. See your IH Engine Dealer or Distributor soon. Discover what International power can do for you!

INTERNATIONAL®
IH ENGINES

International Harvester Co.,
A COMPLETE POWER PACKAGE
180 North Michigan Ave., Chicago 1, Ill.

CUT 20" CAST IRON PIPE
in Less Than 8 Minutes...

...with the New REED
ROTARY CUTTERS
(4 sizes cover the range from 20" cast iron to 24" steel pipe)

These one-man Reed Rotary Cutters cut large diameter steel or cast iron pipe *faster and better than the heaviest power machines* . . . and without electrical or explosive hazards. What's more, there's less digging in ditch-work! You need only a 4" to 6" channel under the pipe and a 45° to 60° arc for the handle swing. Reed Rotaries are easy to "carry in", too. The 20" size weighs only 68 pounds; separates into 3 easily carried parts. Patented pipe guide assures clean, right-angle cuts. Four razor blade wheels track perfectly, cut easily and are quickly interchangeable for steel or cast iron pipe.

● Write today for descriptive literature.

These typical cuts on 12, 16, 20 and 24" cast iron pipe illustrate the clean, accurate, right-angle cuts provided by Reed Rotary Cutters.

REED
REED MANUFACTURING COMPANY
ERIE • PENNSYLVANIA

Daniel A. Okun is Head of the Department of Sanitary Engineering in the School of Public Health at the University of North Carolina, coming to the University from Malcolm Pirnie Engineers in New York in 1952.

After two years in the PHS, partly on the Ohio River Pollution Survey, he joined the Sanitary Corps of the Army, serving during the war with the Corps of Engineers in Newfoundland and Latin America, and then in command of a malaria control detachment.

Dr. Okun studied civil engineering at Cooper Union and California Institute of Technology, and obtained his doctorate in sanitary engineering at Harvard University. His research at Harvard on oxygen in waste treatment was awarded the Kenneth Allen Memorial Award of the NYSIWA and the Harrison Prescott Eddy Medal of the FSIWA.

He headed the Joint Committee of ASCE and FSIWA responsible for the new Manual of Practice on Sewage Treatment Plant Design and is currently a member of the Advisory Committee for the Revision of the PHS Drinking Water Standards. He is a Diplomate of the American Academy of Sanitary Engineers and a Fellow of the APHA.

Dr. Okun has been Project Director of a $200,000 UNC project with ICA to assist the Faculty of Sanitary Engineering of the National University of Engineering in Lima, Peru. Since 1954, Dr. Okun has been Technical Consultant to Public Works and has been largely responsible for the sanitary engineering research series.

Folk and square dancing occupy his "leisure." He plays tennis in summer and squash in winter, but his proudest athletic achievement was coaching the Tigers to the Chapel Hill Little League championship.

The Okuns and their two children are sailing this summer for a year in the Netherlands, where he will be a National Science Foundation Senior Research Fellow at the Technological University in Delft and the Research Institute for Public Health Engineering in The Hague.

add control valves replace old valves FAST with new MUELLER® Cut-In Sleeves & Valves

■ New control valves can be added to your system and old, inoperative valves can be replaced quickly with Mueller Cut-In Sleeves and Valves.

Installation is fast and simple. New Mueller Mechanical Joints on both sleeve and valve are large enough to fit class "D" pit-cast pipe and small enough to be used with class "150" centrifugally cast pipe.

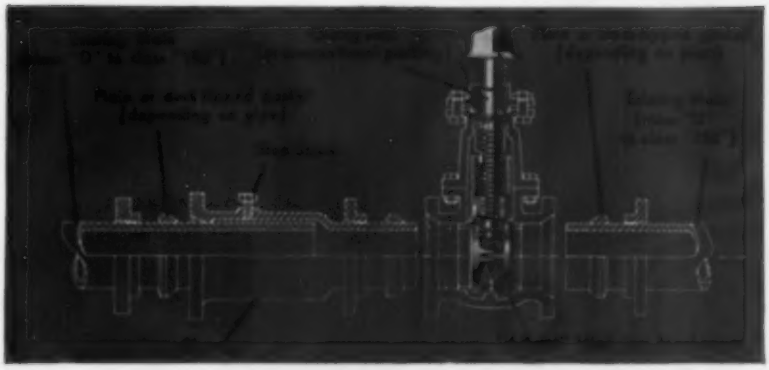
Only two gaskets are used. A solid rubber gasket is used with all larger classes of pipe, such as class "D". A special rubber gasket, reinforced on both ends with duck to prevent cold flow, is used with all smaller classes of pipe.

These two gaskets, each accurately sized to the class of pipe, make installations faster, simpler and cheaper. Joints are permanently tight, too.

Write for full information.

MUELLER Cut-In Sleeve and Valve installed in main

Standardize on* MUELLER *valves with exclusive "4-Point" wedging mechanism.



The wedging mechanism of Mueller Cut-In Valves is identical to that of Mueller AWWA Gate Valves and Tapping Valves. Parts are interchangeable. Standardize on Mueller.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles
In Canada: Mueller, Limited; Sarnia, Ontario

Operate the sanitary landfill — using clamshell or dozer action to spread refuse evenly. Then use "carry-type scraper" action to cover the refuse evenly on-the-go. And then iron down the cover with compactor plate action for a positive seal!

Only the clam-action 4-in-1 gives you built-in "equipment

As "standard equipment" at no extra cost the exclusive clam-action International® Drott® 4-in-1 gives you the utility of a whole fleet of specialized machinery!

The four actions of the 4-in-1 are built in! Each action is instantly available for big-capacity performance, at your touch of the "machine-selector" lever!

Skid-Shovel action puts power-shovel-like pry-over-shoe break-out action at your command. Bulldozer action gives you a "radius-controlled" blade that can dig and move earth like a specialized dozer. "Carry-type Scraper" action can grade, strip, and spread with inch-close accuracy. Clam-shell action can back-drag materials; boil itself full on-the-go; stand and grab hard-to-handle materials; give positive, self-clean-out bottom dumping!

You get all four of the inbuilt actions for the 4-in-1's one moderate price. Each 4-in-1 action "doubles" for one or more specialized machines. You adjust and control hydraulically each 4-in-1 action to get an amazing range of job-handling working positions!

Add up the thousands of dollars you'd save with the 4-in-1 to handle your community's sanitary landfill, as no "single-action" loader can—and to give 4-in-1 multi-operation utility, all over town! See your International Drott Distributor for a demonstration!

Eliminate the sticky materials handling problem, with exclusive clamshell bottom dumping. Opening the clam pulls sticky materials from clam surfaces—gravity pull does the rest, to dump sticky materials that stop ordinary loaders cold!

Dig up "tired" street surfacing using famous 4-in-1 pry-over-shoe break-out action. The TD-15 4-in-1 can exert 39,200 lbs. of break-out force—ample to dig up and load out old brick-and-mortar pavement—and take slam-bang tough jobs from boom-type rigs!

International Harvester Company, Chicago 1, Illinois
Drott Manufacturing Corp., Milwaukee 15, Wisconsin

INTERNATIONAL®
DROTT®

Rough-out a new street or drive, and remove excess material at the same time—using 4-in-1 "carry-type scraper" action for rough and finish grading. Spread surfacing materials with "scraper" action or spot-place it with clamshell!

You can sit, grab, and lift tough-to-handle "impossibles" like stumps, slabs of concrete, and other materials—as no other equipment can! Four-in-one clam-action is the *only* answer!

fleet" utility!

MUNICIPAL YEAR BOOK, 1960

New topics covered in the 1960 edition of the Year Book include parking lots and meters in more than 1,000 municipalities over 10,000 population with data provided on number of parking lots and spaces available; whether a fee for use of a lot is charged; the number of parking meters; time limits; and rates. Also new is a section surveying housing standards in force for existing housing in 229 cities. This includes information about the enforcement agency; its staff; types of standards; inspection policies; and the types of codes used to enforce housing standards. For the first time there are reviews of municipal in-service training activities and activities of state associations of county officials.

There are 21 major tables containing information about individual cities. This information is analyzed and summarized. Consolidated data are provided for groups of cities classified according to population groups. Orin F. Nolting and David S. Arnold, editors. International City Managers' Association, 1313 East 60 Street, Chicago 37, Illinois. 590 pp. $10 postpaid.

ROLLERS AND RADIO ON HIGHWAY CONSTRUCTION

This 44-page bulletin contains two papers presented at the recent Highway Research Board meeting. One, by C. F. Parker, on steel-tired rollers gives recommendations on their use in paving work. The other, by H. R. Craig and J. W. Krichbaum covers planning, installation and use of 2-way radio in maintenance and construction. 80 cents from Highway Research Board, 2101 Constitution, Washington, D. C.

HIGHWAY RESEARCH IN THE UNITED STATES

This is a 119-page report of a special committee on the needs, expenditures and applications for research in highway fields. It discusses and lists the most urgent areas of investigation and calls for an expenditure over the coming four or five years of $34 million. The listing includes 19 broad areas of research adjudged to rate A-1 in importance and urgency. Highway Research Board, 2101 Constitution Ave., Washington, D. C. $2.80.

ASPHALT PAVING TECHNOLOGY

The Proceedings of the Association of Asphalt Paving Technologists for 1959 is available in book form. Consisting of 17 papers, the Proceedings cover paving asphalts, aggregate gradations, fillers, stability, density, pavement failures, fatigue tests, chemical composition of asphalts, mixing efficiency, durability and the interrelated effects on the rheological characteristics of asphalts. Ward Parr, Secretary-Treasurer; Association of Asphalt Paving Technologists; 1224 East Engineering Building, Box 619, Ann Arbor, Michigan. $6.50.

HOUSE NUMBERING AND WATER SERVICE

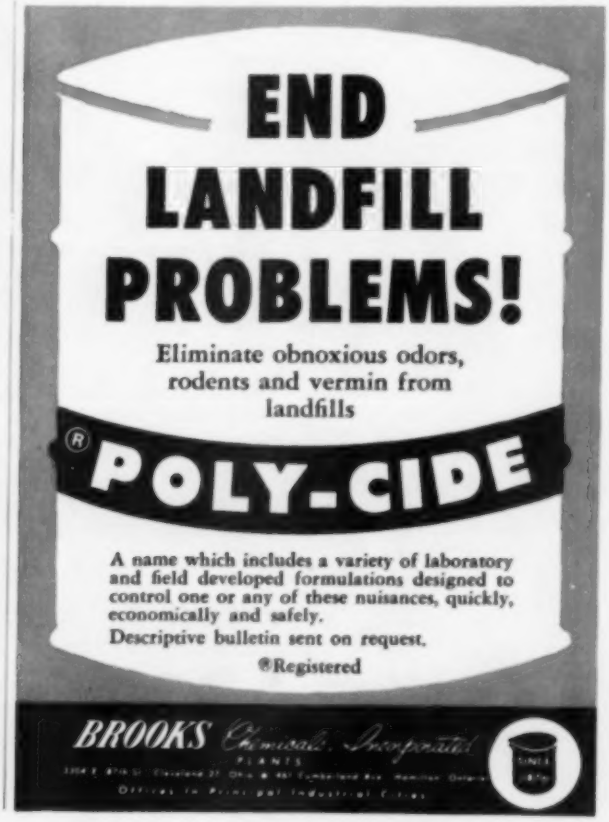
Two recent ordinances, adopted by Gainesville, Ga., are of interest to many communities. The ordinance on house numbering covers

SPEED SENSITIVE SWITCHES

All GH series of cable driven governors and switches are available in this GH-E series. This housing meets the specifications for class 1 group D, Explosion Proof Equipment. For further information, write for Bulletin 504-A.

SYNCHRO-START PRODUCTS, INC.

8151 N. RIDGEWAY AVE. SKOKIE, ILLINOIS


END
LANDFILL
PROBLEMS!
Eliminate obnoxious odors, rodents and vermin from landfills
® POLY-CIDE
A name which includes a variety of laboratory and field developed formulations designed to control one or any of these nuisances, quickly, economically and safely.
Descriptive bulletin sent on request.
®Registered
BROOKS Chemicals, Incorporated
PLANTS

EVEN BELOW WATER TABLE LEVELS...

New Compression Joints are the Answer to Infiltration

CITY OFFICIALS: R. N. Christmas, Mayor; Arthur E. Darlow, City Engineer

CONTRACTOR: Reinertson Construction Co., Inc., Miami

Reid Acres Sanitary Sewer District—one unit in a $300 million project—serves both residential and industrial areas in Greater Miami, Florida's sewer network. Vitrified Clay Pipe was specified for the entire project, because of its outstanding record of long-time maintenance-free service.

In many sections, trenches had to be dug to depths below water table levels. In spite of this, new factory-made, compression jointed Clay Pipe went in fast . . . solved the infiltration problem.

Easy installation and superior infiltration resistance are only *two* of many important benefits offered by modern Clay Pipe. Because it is chemically-inert, it does not rust, rot, deform or corrode. And smooth, vitrified interiors assure free flow at rated capacities, keeping pumping costs down. *Only* Clay Pipe has *all* the features you can trust.

WRITE TODAY for assistance in fitting Clay Pipe into your sewer project . . . and be sure of the lowest cost with the best performance.

C 650-2

Vitrified **CLAY PIPE** *Never Wears Out*

NATIONAL CLAY PIPE MANUFACTURERS, INC. 1820 N Street, N. W., Washington 6, D. C.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio • 445 Ninth St., San Francisco 3, California • Box 172, Barrington, Illinois • 1401 Peachtree St., N.E., Atlanta 9, Georgia

...and think before you use paint again

TRAFFICAIDE® MARKERS

are safer because they show brighter—last longer

Motorists and pedestrians rely on your traffic markers for their very lives. Don't let them down. Use only those markers that can stay fresh and alive —that can outlast weather and wear. TRAFFICAIDE specialized pavement markers meet these vital requirements. Fourway reflective, they flash their warning message around the clock, rain or shine, dark or light.

And TRAFFICAIDE markers suffer little from the elements or the passage of time. Made of a specially compounded vinyl, they are tapered and precoated for lifetime bonding to any pavement. In fact, road tests using both paint and TRAFFICAIDE markings reveal that TRAFFICAIDE outlives paint by more than ten to one.

easy on your budget, too!

Only TRAFFICAIDE's quick-setting mastic is needed for secure bonding to any pavement. Markers dry into place immediately. Traffic flows freely, releasing traffic control personnel for productive work. But the greatest saving of all is the extremely low maintenance cost that keeps your traffic marking system at peak efficiency throughout the years ahead.

TRAFFICAIDE markings include directional arrows; crosswalks; square—rectangular and diamond shapes; lane —berm and no passing lines; parking or car limits; letters, words and numerals.

TRAFFICAIDE CORPORATION

AUBURN, N. Y.

Clip this to your letterhead: 0

Gentlemen:

Please send me without obligation your new folder on TRAFFICAIDE Long Life Specialized Pavement Markers with general specifications.

base lines, quadrants, diagonal streets, numbering, assignment of numbers, street names and new subdivisions. The water service ordinance includes line location, extensions to subdivisions, sizing of lines, cost of extensions and methods of financing and provisions for extension, renewal and maintenance. George Whiten is City Manager.

PUERTO RICO AQUEDUCT and SEWER AUTHORITY

The annual report for 1959, an excellently prepared 34-page booklet, contains many items of interest. For instance, 29 emergency power generators have been installed in filtration plants and deep wells to insure continuity of supply in case of power failure. For rural settlements, 60 new rural water systems have been constructed. Much of the report is devoted to the financial status. The Authority headquarters are in San Juan, P. R. R. V. Urrutia is Executive Director.

CAPITAL PROGRAM FOR PHILADELPHIA

The proposed capital program for Philadelphia, Pa., for the years 1960-1965 has been published. This report is attractively presented with illustrations and charts. 190 pages. The Philadelphia City Planning Commission, City Hall, Philadelphia, Pa.

STRUCTURAL MECHANICS

According to the author, this book is intended to present fundamental principles of structural mechanics so as to provide a sound background for further extended study in structures. Calculus and differential equations are employed. By Samuel T. Carpenter, Professor of Civil Engineering and Chairman of that Department, Swarthmore College. 532 pages, illustrated. John Wiley & Sons, Inc., 440 Fourth Ave., New York. $9.50.

WATER RESOURCES IN RENSSELAER CO., N. Y.

This is a publication of the Rensselaer Co., N. Y., Health Department, Troy, N. Y. Essentially, it is a report on the most feasible way to develop and better utilize the existing water resources of the County. Primary emphasis in this report is on a population study of the county. This indicates that eventually 85 percent of the total population will be living in one-fourth of the total area and adjacent to or between the two principal cities. A second report is scheduled for the near future.

LOUISIANA—This is one of two Huber-Warco maintainers owned by St. Tammany Parish, Covington, Louisiana. They are used in maintaining parish roads, drawing a pull type grader as shown, ditching, loading dirt and stone into trucks, handling tile with the lift loader, and handling other jobs around the parish. The parish also owns two Huber-Warco motor graders.

HUBER WARCO

HUBER-WARCO *maintainers*

"Nine Machines In One"

VERSATILITY and year 'round performance are two important benefits of a Huber-Warco Maintainer. The basic machine has a nine-foot power sliding moldboard for routine grading work. Hydraulic controlled attachments quickly convert the Maintainer for service as Bulldozer, Lift-Loader, Scarifier, Berm Leveler, Side Dozer, Broom, Patch Roller and Snow Plow.

TORQUE CONVERTER combined with 45½ H.P. gasoline engine gives plenty of power for toughest jobs. Converter reduces shock loads, prolongs machine life, increases work capacity and cuts fuel consumption.

WORKING SPEEDS range from 1.7 to 8 M.P.H. Travel speed is 21 M.P.H. for quick movement between jobs. Weight is 6,250 lbs.—7,205 lbs. with calcium chloride in tires.

A complete line of optional equipment, in addition to the hydraulic attachments, is available for the Maintainer.

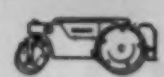
A trusted product name backed by respected distributor names from coast to coast

MOTOR GRADERS

Standard transmission models from 83 to 160 H.P. Torque converter and power shift transmission models from 102 to 195 H.P.

TANDEM ROLLERS

3-5 Ton • 4-6 Ton Retractable • 5-8 Ton • 8-10 Ton • 8-12 Ton • 10-14 Ton



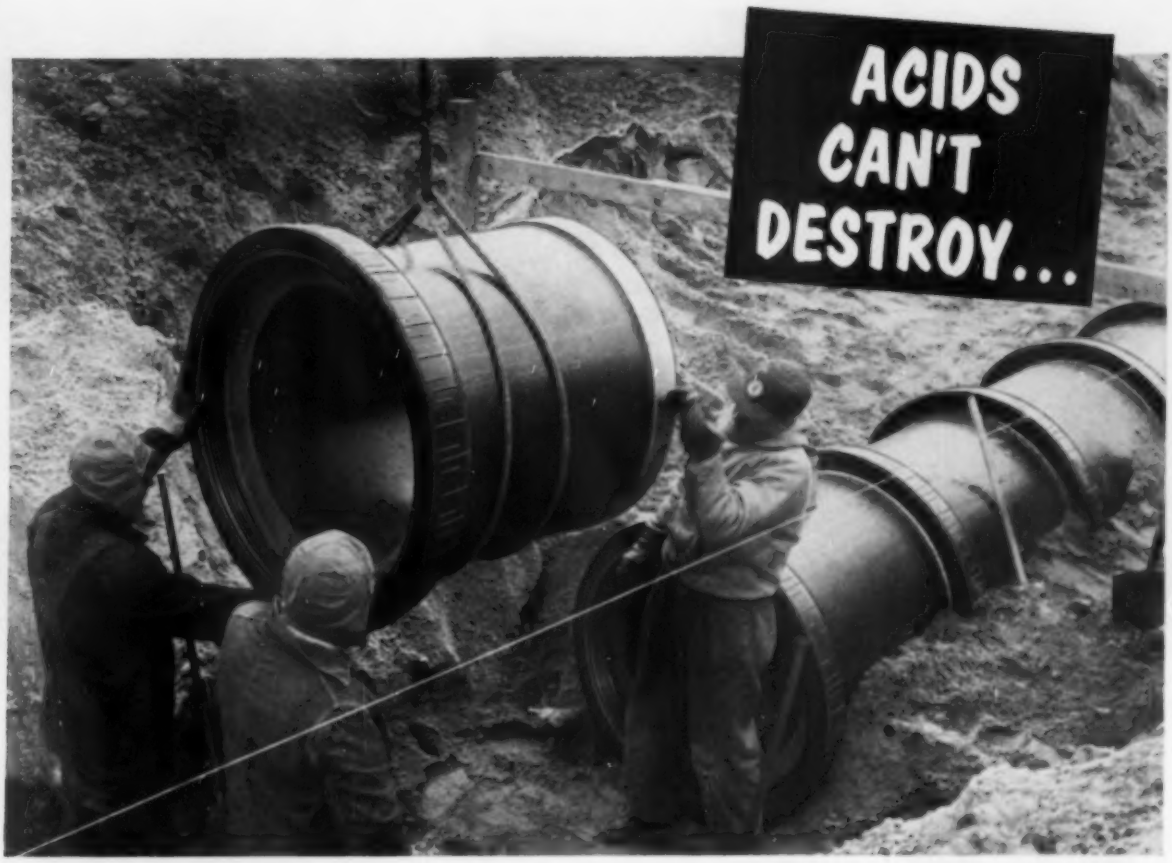
3-WHEEL ROLLERS

10-Ton • 12-Ton • 14-Ton Standard Weight 10-12 Ton • 12-14 Ton Variable Weight

MAINTAINER

M-52 — 45½ H.P. Attachments are Lift-Loader, Broom, Bulldozer, Patch Roller, Scarifier, Snow Plow, Berm Leveler

HUBER-WARCO COMPANY **Marion, Ohio, U.S.A.**



UNIVERSAL *flexible-coupled* VITRIFIED CLAY PIPE

This pipe line was built to carry not only sewage, but also the acid-laden wastes from a chemical plant. Designers of the double-duty line made *doubly* sure of complete acid-resistance throughout by using Universal Vitrified Clay Pipe, coupled with equally acid-resistant neoprene flexible gaskets.

The line was constructed for the Cincinnati-Toms River Chemical Co., Toms River, New Jersey. A. M. Kinney Inc., Cincinnati, Ohio, were Architects and Engineers. 27" A.S.T.M. C-200 Vitrified Clay Pipe with Tylox neoprene flexible couplings was installed by Riggs Distler & Co., Baltimore, Md.

Design and build *your* waste disposal lines for everlasting immunity to sewerage and industrial waste acids. Plan on using Universal Vitrified Clay Pipe and Flexible Couplings. Contact us for details.

6095

UNIVERSAL SEWER PIPE DIVISION

UNITED STATES CONCRETE PIPE CO.

A Subsidiary of Pittsburgh Coke and Chemical Company

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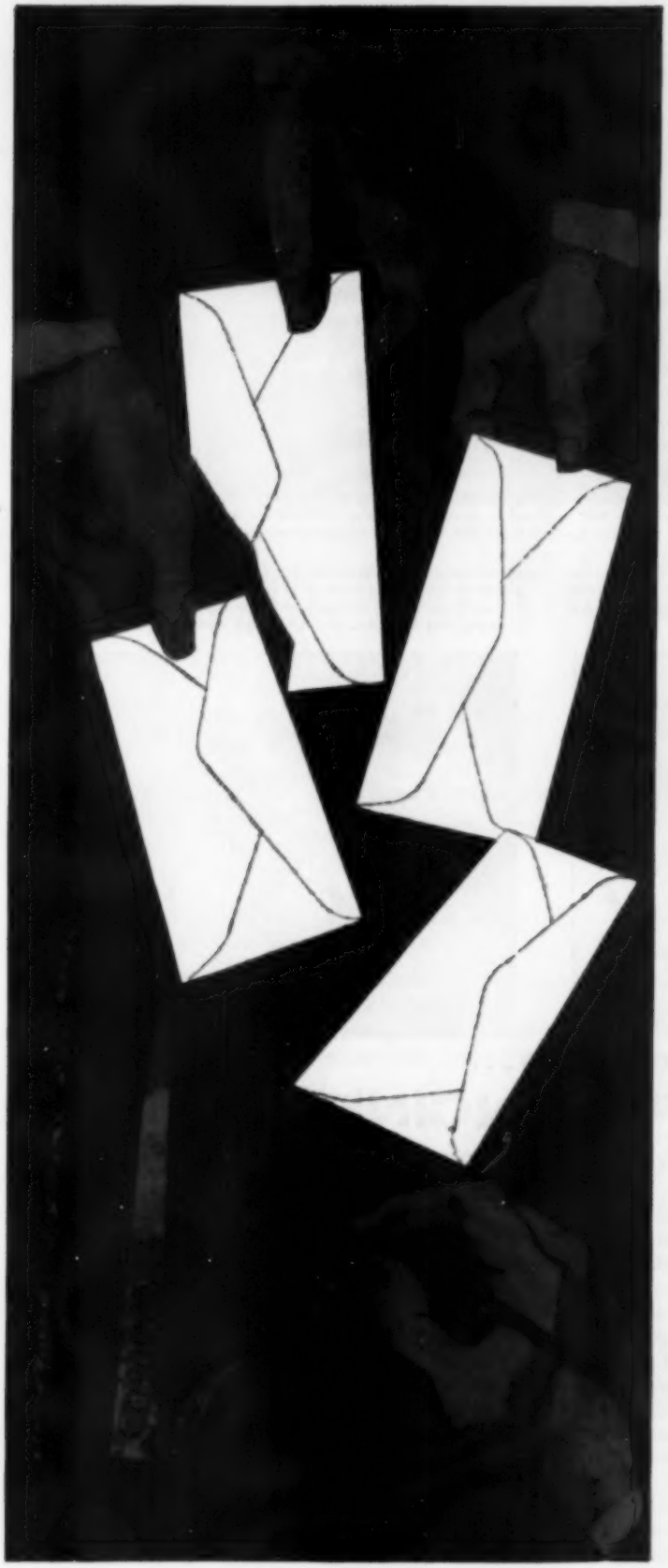
Cincinnati 44, Ohio, Box 536 ..... Tel. LO-1-7846
Ft. Lauderdale, Fla., Box 958 ..... Tel. LU-3-7220
Kalamazoo, Michigan ..... Tel. DA-7-3016
Pittsburgh 25 (Neville Island), Pa. ..... Tel. FE-1-5848

GENERAL OFFICES • 1500 Union Commerce Bldg. • Cleveland 14, Ohio • Tel. MAIN 1-5240



How to be sure you make the right choice after the Rock Salt bids are in

FIRST consider the company behind the product. What is its reputation, who does it serve, what are its resources? In terms of reputation, service and resources, the Morton Salt Company is the leader in the industrial salt field. Morton's outstanding reputation has been built on years of service to industries and municipalities throughout the United States. Now Morton, America's only nationwide salt company, can offer rock salt for ice control to users everywhere in the country from conveniently located salt sources and warehouses. And Morton numbers among its rock salt customers hundreds of towns and cities and many of the nation's counties, states and toll roads.

NEXT satisfy yourself that the bidder can keep his promise. Make sure he can deliver rock salt from a source near you, the fastest and most economical way. To better serve rock salt customers in the East and Midwest, Morton recently opened a giant new rock salt mine strategically located at Fairport, Ohio. The storage, loading and transportation facilities at the Fairport Mine, like the facilities at other Morton sources, insure you prompt delivery on whatever quantity of rock salt you order.

NOW make your purchasing decision. Base it on your evaluation of the company, its record and its ability to serve you. When you decide on Morton you can rest assured that you have made the wisest choice. You can depend on Morton to give you dependable prompt service on the rock salt you need, when you need it.

MORTONSALT COMPANY

INDUSTRIAL DIVISION

110 No. Wacker Drive, Chicago 6, Illinois

The new incinerator at Whitemarsh. Note the neat compact lines of the building and the low stacks of the wet scrubbers which emit only a plume of steam. Glace & Glace Inc. were consulting engineers for the project.

Only these four men are needed to operate the plant: One man to weigh incoming trucks and supervise unloading, a second to operate the conveyor, a third to load and drive the truck carrying away the non-combustible residue, and a supervisor.

Storage conveyor consists of two, 50-ton capacity oscillating hoppers placed side by side but independently controlled. Material is moved to feeders in a series of short reciprocating arcs. This action is self-scouring and keeps the storage trough completely clean.

NOW SERVING 50,000 RESIDENTS . . .

NEW PRINCIPLE INCINERATOR

eliminates mess and fumes—is economical to operate

Designed to burn 12½ tons of refuse *per hour* without odor or dirt, this new incinerator is in operation at Whitemarsh, Pa. In addition to garbage, tin cans, lawn trimmings and wastepaper, the incinerator handles undigested sludge from an adjacent sewage plant. Located in a residential section, plant exterior and landscaping are designed to harmonize with their surroundings.

The Dravo Incinerator has a number of unique features. Of primary significance are: the continuous flow design, which permits rapid and easy handling of the refuse; the water wall furnace, which permits the use of sufficiently high temperatures to provide thorough combustion and the elimination of noxious odors; and the wet scrubber and residue disposal system, which together promote the maintenance of healthful cleanliness.

Automatic operation has been stressed, only four men are required to run the entire plant. Present needs demand operation of the plant for only one 8-hour shift, but since it can be run on a 24-hour basis, there is adequate capacity for future needs.

The Dravo Incinerator is the economical solution to the problem of sanitary, convenient refuse disposal. For full information, write or call DRAVO CORPORATION, PITTSBURGH 22, PENNSYLVANIA.

DRAVO
CORPORATION

SPECIAL REPORT TO CATERPILLAR OWNERS:

CAT CATERPILLAR

Parts you can trust
... cost less per hour

Converting to Lifetime Lubricated Track Rollers costs less than you think

Lifetime Lubricated Roller Groups, including seals, shafts and end collars, *cost only a little more* than ordinary Bellows Seal Rollers without end collars. But this small expense of *initial* installation rapidly disappears through noticeably lower owning and operating costs.

Based on savings from seal replacement alone, Lifetime Lubricated Rollers soon make up the difference. The metal rings of the Floating Ring Seal can be used over and over again. Take a 14-roller D8. At every roller rebuild, you probably have to buy 28 bellows seals @ $3.97* each or a total of $111.16. Compare this with the rubber "O" rings costing a total of only $45.08*. You save $66.08 in seal replacement costs every time you rebuild or replace. Similar savings are available on all models. And, replacement Lifetime Lubricated Roller and shaft assemblies without end collars are priced below those of Cat Bellows Seal Rollers.

But your savings don't end here! Here are other benefits you get from Lifetime Lubricated Track Rollers:

1. Longer Lived Roller Shells and Component Parts. The Lifetime Lubricated Roller is much stronger and has more metal in the wear zones, specially hardened for extra resistance to wear. And bushings, bearings and shafts are larger and stronger and will last longer. These components are *always* bathed in *clean*, heat-dissipating oil (not grease). Dirt just can't get in to accelerate wear—oil can't get out, thanks to the patented Floating Ring Seal. This means you won't be buying as many replacement bushings and shafts at rebuild or roller replacement time.

2. Maintenance is Eliminated. Lifetime Lubricated Rollers need no servicing until they're finally rebuilt. You don't have to spend any time nor money for lubrication during the rollers' lives.

3. Easier Installation. Snap-on rings hold seals and end collars in place *before* mounting. End collar bolt holes line up easily with track roller frame holes at installation. Your tractors will be on the go much sooner.

See your Caterpillar Dealer. He'll give you the complete facts on the economy of investing in Lifetime Lubricated Rollers ... for *all* Caterpillar track-type equipment.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U. S. A.

* Suggested consumer prices for these Caterpillar parts

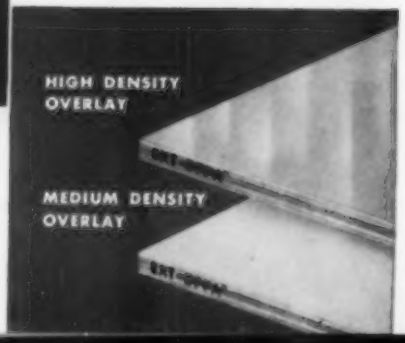
SERVICE TIP: Lifetime Lubricated Rollers need no servicing. But when rebuild time finally comes, keep metal rings matched in original pairs.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

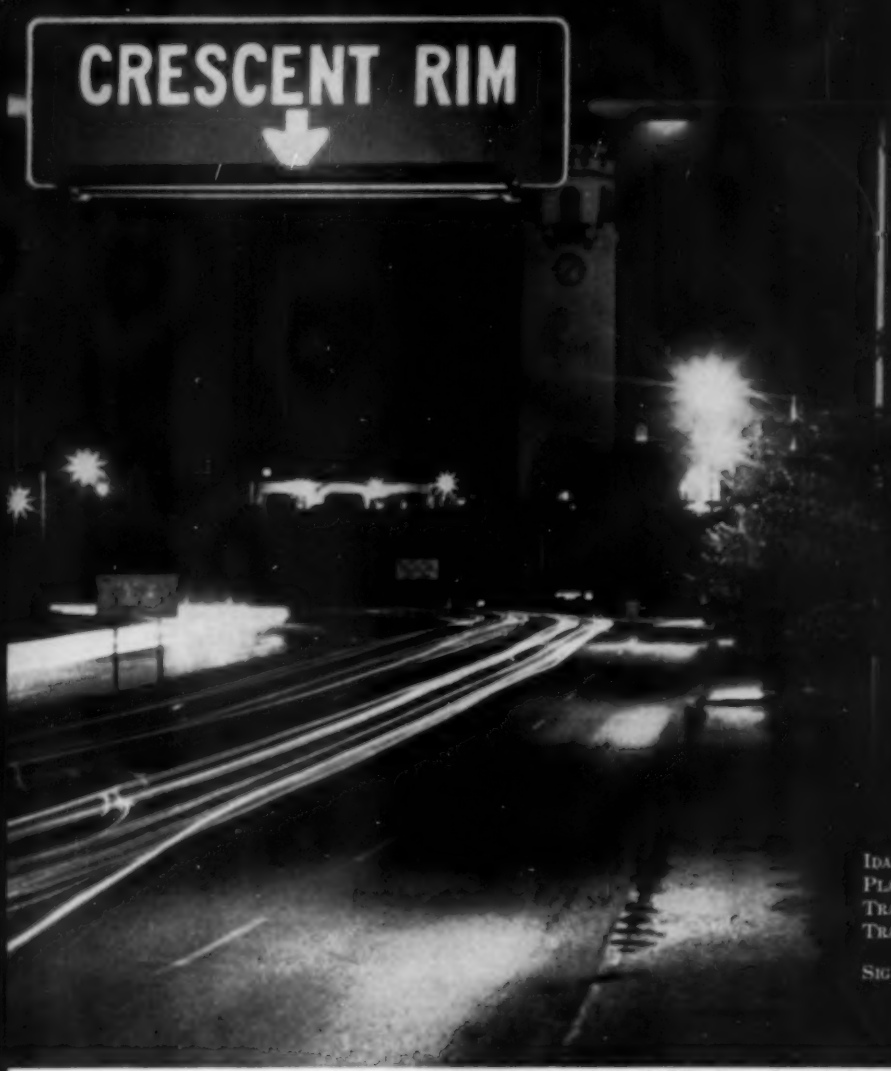
Idaho cuts maintenance with quality signs

On standard black-background informational signs, reflective letters are applied directly to black High Density overlaid plywood, eliminating painting.



High Density overlaid plywood needs no protective painting; color (black, brown or amber) is in the overlay. Medium Density is for plain painted signs. Base panel is waterproof Exterior plywood.

and replacement costs of overlaid fir plywood



IDAHO STATE HIGHWAY DEPARTMENT
PLANNING & TRAFFIC ENGINEER: E. L. Mathes
TRAFFIC ENGINEER: M. W. Lotspeich
TRAFFIC REGULATION & CONTROL ENGINEER: John Boesel
SIGN SHOP SUPERINTENDENT: W. B. Woods

Illuminated for maximum night-time legibility this overhead installation is prime example of Idaho's efficient signing system.

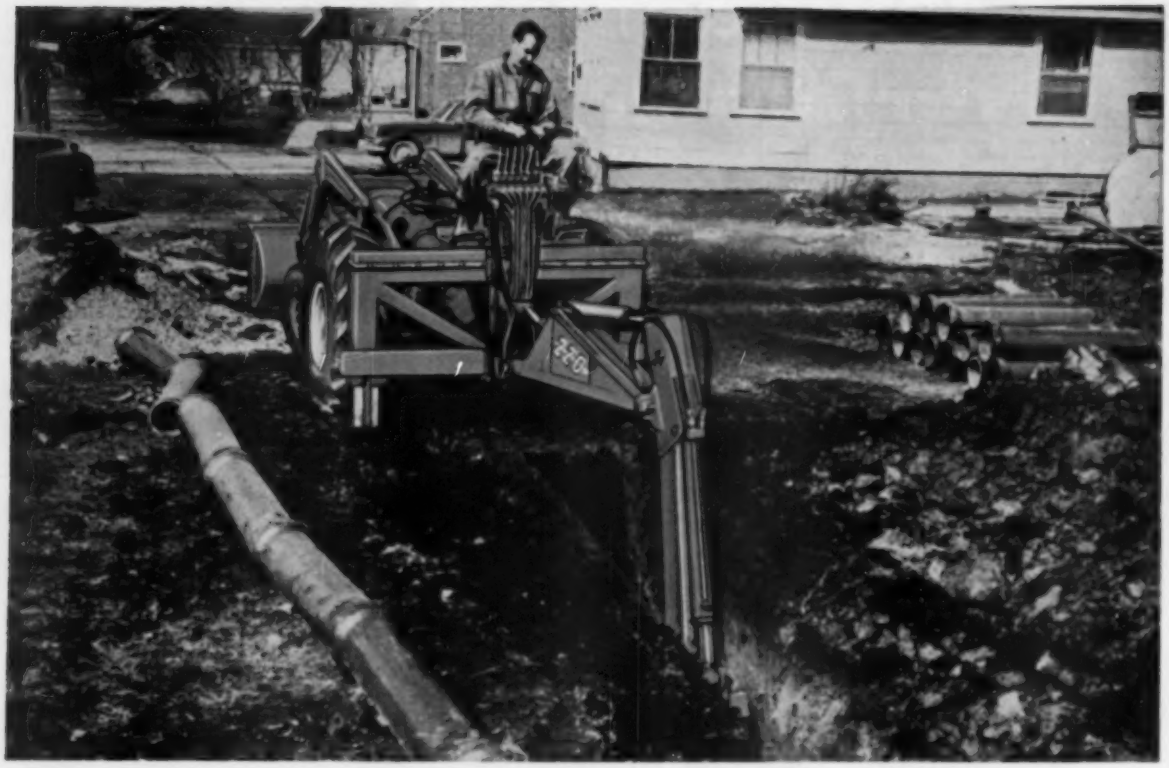
OVER 7,000 MODERN OVERLAID PLYWOOD SIGNS of every type and size help make motoring a pleasure on Idaho's scenic highways. They also help the state highway department do a better signing job at considerable savings to taxpayers.

Until 1953, when Idaho switched to High Density overlaid plywood, maintenance and repair had been a constant problem. Weathering is unusually severe; temperature ranges from 115° above to 40° below zero. Vandalism damage from hunters in isolated areas and resultant progressive deterioration were particularly troublesome. Under these rugged conditions, overlaid plywood has performed consistently well—particularly in areas where signs are subjected to unusual abuse. As a result, maintenance costs have dropped sharply.

Initial fabrication and installation costs are also less. Records at the Idaho sign shop in Boise show a completed overlaid plywood sign costs between 10 and 15 percent less than aluminum.

DOUGLAS FIR PLYWOOD ASSOCIATION
TACOMA 2, WASHINGTON
—a non-profit industry organization devoted to research, promotion and quality control

DFPA TESTED QUALITY



Here's why the MASSEY-FERGUSON BACKHOE *"CAN DO" so much more for you!*

DIGS FLUSH — The entire mast, boom, and operator's seat can be shifted to either side in five minutes for flush digging. Notice that the operator is still sitting right in line with his work.

VISIBILITY — The operator is always right above his work — lets him dig in ticklish areas without a "watcher." The seat rotates with the boom so he's facing the bucket when he's dumping the load, too.

There are plenty of reasons why the Massey-Ferguson Backhoe is the most popular backhoe on the market, but they all add up to just one fact — **it will make more money for you!**

First, it will work in practically any situation. It was the first backhoe to dig flush alongside buildings, walls, etc. It also digs at right angles to the tractor so you can work in areas where other backhoes can't even stretch out. With 14,000 pounds breakout power it digs through frozen ground and blacktop.

Next, it provides unexcelled visibility. The operator is always sitting right in line with the bucket — whether he's digging or dumping — and he's above the trench with an unobstructed view of his work. The seat rotates with the boom.

There are many other features, such as the vertical stabilizers and five-minute detachability, but let your Massey-Ferguson dealer show you why it pays to buy a Massey-Ferguson Backhoe!

Why Wait? — Set a Date — We'll Demonstrate!

MASSEY-FERGUSON INDUSTRIAL DIVISION
Block 1000 South West St., Wichita 13, Kansas
Producing Sizeable Power for the "Sensational 60's"

MF60-28

There's One Compact Car With Proven Fleet Experience...

IT'S RAMBLER!

Proven By 10 Years and 25 Billion Owner-Driven Miles

RAMBLER IS CUTTING FLEET COSTS IN COMMUNITIES ALL OVER THE COUNTRY!

For Complete Information On How **RAMBLER** *Can Cut Your Fleet Costs . . .*

Experience has proven that public works departments and other governmental units can save important budget money when they switch to Rambler for their fleet requirements. Why not investigate Rambler's proven savings today?

- **Proven Lowest First Cost**—Rambler offers America's lowest-priced cars.
- **Proven Top Economy**—Rambler is the recognized economy king—proven so in official tests and in owner use.
- **Proven Highest Resale Value**—Both leading national used car services—N.A.D.A. Used Car Guide and Red Book Market Reports—show Rambler has the top resale value of all low-priced cars.
- **Proven Stronger Single-Unit* Construction**—More than twenty years' experience enables Rambler to build the strongest, safest all-welded Single-Unit construction. Only Rambler offers *complete* unitized construction on all models.

*Pioneered by American Motors

SEE YOUR RAMBLER DEALER
or write or wire
FLEET SALES DEPARTMENT
DEPT. S-7
AMERICAN MOTORS CORP.
14250 Plymouth Road, Detroit 32, Michigan

Equipment and Materials for your PUBLIC WORKS PROGRAM

The engineering information in these helpful catalogs will aid you in your Engineering and Public Works programs. Just circle numbers you want on the reply card, sign and mail. This free Readers' Service is restricted to those actively engaged in the public works field of cities, counties or states.

NEW LISTINGS

Telemetering and Remote Controls

45. . . . for water supply systems are clearly described in three circulars: 5903 for monitoring and telemetering, 5905 for circuit scanner, and 5906 for audio tone systems. To get all or any one write Femco Inc., Irwin, Pa., or circle the card-number.

Cost-Saving Sludge Removal Equipment

46. A new 12-page bulletin explains how Rex Unitube Sludge Removers for municipal and industrial waste treatment speed removal time and permit substantial savings in equipment costs. All tank designs are covered by data in this comprehensive bulletin, No. 315-81. Get your copy from Process Equipment Div., Chain Belt Company, Box 2022, Milwaukee 1, Wisc., or use the handy inquiry card.

External Joints for Concrete Sewer Pipe

47. Cadilloc external rubber joints fit any pipe—not just some. Allows flexibility, stores well and makes tight joints. For valuable illustrated booklet, address Cadilloc, Inc., 300 Haynes St., Cadillac, Mich., or circle this card-number.

Armco Steel Buildings

58. Both large and small, commercial and social are shown for you in a new catalog that is a work of illustrative art in color. Gives you the figures you need, too, for planning and design. Write Armco Drainage and Metal Products, Inc., Middletown, Ohio, or circle our card-number.

Loader Scoops While Tractor Stands Still

67. That's the nutshell story of the new Power-Crowd Loader, which pushes bucket into the dirt pile for a full ¾-yard load, lifted by heavy-duty lift cylinders. You will want this new bulletin. Address Dept. 762, A. C. Anderson, Inc., P. O. Box 391, Wildwood, N.J., or circle our reply card.

Blowers for Activated Sludge

54. . . . are described in this bulletin for consulting engineers. Suggested specifications are included. Just write for Bulletin 142c to The Spencer Turbine Co., New Park Ave., Hartford 6, Conn., or circle above card-number.

New Literature on Tractor Loaders

55. Full illustrated descriptions on Allis-Chalmers TL-12 and TL-14 Tractor Loaders are furnished in bulletins MS-1386 and MS-1373 respectively. Write Allis-Chalmers Construction Machinery Div., Milwaukee 1, Wis., or circle our inquiry card.

A Chlorinator That is Versatile

61. . . . is described in new 8-page catalog describing the Controlomatic Chlorinator, available in both manual and automatic models, in capacities from 3 to 2,000 pounds per day of chlorine gas. Get your copy from Fischer & Porter Co., 548 Jacksonville Road, Warminster, Pa., or circle our reply card.

Stop Swimming Pool Joint Leaks

66. Once in place, these synthetic rubber sealing compounds never let go again. Simple to apply. Write now for "Seal Pool Joints" folder and list of suppliers to Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton 7, N. J., or circle our card number.

High Frequency Resistance—Welded Steel Pipe . .

72. Available in 6" to 16" diameters, in wall thickness to .219, special wrappings and coatings available. For attractive booklet, including specifications and details of field joints write Valley Mfg. Co., Valley, Neb., or circle our inquiry card.

"DUO-PACTION" is Real Compaction!

73. The workings of compaction and surface rolling with a single machine is described in well-illustrated brochure SG25-5812 which also covers Seaman-Gunnison Scrapers, Distributors and Flushers. Get the full facts from Seaman-Gunnison Div., Box 3025, Milwaukee 18, Wisc., or circle our reply card.

Fallacies of the "Low Bid"

78. . . . were never better exposed than in this thoughtful new booklet titled "The Best Bid for Your Budget." Reveals the hidden factors that often make the "low bid" the high bid in purchasing motor graders. For your copy of Form E014, write Caterpillar Tractor Co., Peoria, Ill., or check the inquiry card.

Big Tractor Shovels for Big Jobs

93. New 4-color bulletin describes two largest capacity "Michigan" tractor shovels. Gives specifications, illustrations and suggested applications that make these big machines pay. Write for Bulletin TS2500 to Construction Machinery Div., Clark Equipment Co., Pipestone Plant, Benton Harbor, Mich., or circle our card-number.

What You Should Know About Steel Reservoirs and Standpipes

79. The function of ground storage structures in water distribution systems, specifications and maintenance recommendations, are included in an artistic new 20-page booklet. Get yours from Chicago Bridge & Iron Co., 332 So. Michigan Ave., Chicago 4, Ill., or circle our card-number.

Forget the Weather Man—Just Turn on "Rain" When Needed

80. Informative new 24-page catalog describes the Rain Jet system, gives complete descriptions, specifications, operating data and suggestions for use in parks, parkways, and all other public works lawn beautifying. Address Rain Jet Corp., 301 So. Flower St., Burbank, Calif., or circle our card-number.

Automatic Analyzers for Your Water Treatment Plant Laboratory

87. Automatic analyzers for determining alkalinity, chlorine, fluoride, hardness, pH, silica, turbidity—all described in 31-page booklet that is bound to be useful to you. Address Hach Co., Ames, Iowa, or circle our card-number.

Identify and Protect Your Equipment

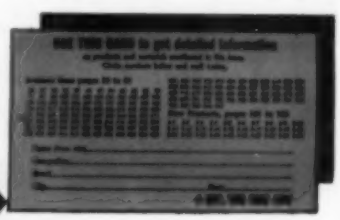
89. . . . with these property identification tags—aluminum, brass, or plastic. Useful for anything that needs clear, permanent marking, from office equipment to furniture and ladders. Ask for Bulletin 807. Write Seton Name Plate Co., 50 Fitch St., New Haven 15, Conn., or circle our reply card.

Where and How to Floodlight

90. Light is thrown on this special subject in 10-page illustrated booklet which contains a wealth of helpful data. "More light per dollar" is its theme. For a free copy just write for Bulletin GEA-7201 to General Electric Co., Schenectady 5, N. Y., or circle our card-number above.

New School-Crossing Traffic Controller

101. Worked out for the stop-and-go irregularities of mid-block school-children crossings, this electronic controller has simple timing adjustments. Folder 2716 tells all. Get yours from Crouse-Hinds Co., Adv. Dept., Wolf & 7th North Streets, Syracuse 1, N. Y., or circle our inquiry card.



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USE THIS CARD to get detailed information . . . . .

July 1960

Please send me literature on the following items described in PUBLIC WORKS:

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20	21	22	25	28	29	37	42	45	46	48	51	53	54	55	58	61
62	63	66	67	68	69	71	72	73	78	79	80	82	87	88	89	90
93	94	96	100	101	102	103	106	107	115	123	128	131	132	133	134	135
137	139	141	143	147	148	149	154	155	162	164	166	168	169	182	184	185
188	189	190	194	195	198	202	211	213	217	222	223	224	230	237	239	249
255	271	273	274	277	279	283	288	290	293	308	322	330	331	339	350	352
361	389	393	395	397	406	414	418	425	434	438	450	462	463	473	476	484
487	496	511	517	525	554	561	579	585	586	595	603	606	608	610	611	615
636	643	656	658	663	665	669	671	672	674	677	681	684	687			

New Equipment Items Appear on Pages 190 to 196

7-1	7-2	7-3	7-4	7-5	7-6	7-7	7-8	7-9	7-10	7-11	7-12	7-13	7-14
7-15	7-16	7-17	7-18	7-19	7-20	7-21	7-22	7-23	7-24	7-25	7-26	7-27	7-28

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Meetings and Conventions

Urban Public Health and Residential Environment Seminar
Southern Illinois University, Carbondale, Ill., Aug. 8-12. Apply to Chief, Training Branch, Communicable Disease Center, 50 Seventh St., N.E., Atlanta 23, Ga.

Pennsylvania Sewage and Industrial Wastes Assoc.
Pennsylvania State University, University Park, Pa., August 10-12. Sec.-Treas., J. R. Harvey, 996 So. Main St., Meadville, Pa.

National Association of County Officials
Hotel Fontainebleau, Miami Beach, Fla., Aug. 14-17. Exec. Dir., Bernard F. Hillenbrand, 1001 Connecticut Ave., N.W., Washington 6, D. C.

American Public Works Assoc.
Manhattan Hotel and The Coliseum, New York, N. Y., Aug. 14-17. Exec. Dir., Robert D. Bugher, 1313 E. 60 St., Chicago 37, Ill.

Robert A. Taft Sanitary Engineering Center Courses and Seminars:
Aug. 15-19, "Recent Developments in Water Bacteriology";
Aug. 22-25, "Water Quality Data Collection and Utilization";
Aug. 29-31, "Water Quality Measurement and Instrumentation."
Dir., 4676 Columbia Pkwy., Cincinnati 26, Ohio.

American Water Works Assoc.
South Dakota Sec., Grand Hotel, Watertown, So. Dak., Sept. 7-9. Sec., J. Darrell Bakken, Div. of San. Eng., State Dept of Health, Pierre, So. Dak.

South Dakota Water & Sewage Works Conference
Grand Hotel, Watertown, So. Dak. Sept. 7-9. Sec., Don C. Kalda, State Dept. of Health, Pierre, So. Dak.

Institute of Traffic Engineers
Edgewater Beach Hotel, Chicago, Ill., Sept. 11-15. Exec. Sec., David M. Baldwin, 2029 K St., N.W., Washington 6, D. C.

American Water Works Assoc.
Kentucky-Tennessee Sec., Andrew Johnson Hotel, Knoxville, Tenn., Sept. 12-14. Sec. Harold F. Mount, 5400 Preston Hwy., Louisville, Ky.

Kentucky-Tennessee Industrial Wastes and Sewage Works Assoc.
Andrew Johnson Hotel, Knoxville, Tenn., Sept. 12-14. Sec.-Treas., S. Leary Jones, 602 Cordell Hull Bldg., Nashville 3, Tenn.

American Water Works Assoc.
New York Sec., Saranac Inn, Saranac Inn, N. Y., Sept. 14-16. Sec.-Treas., Kimball Blanchard, c/o Neptune Meter Co., 22-22 Jackson Ave., Long Island City, N. Y.

American Water Works Assoc.
Virginia Sec., Cavalier Hotel, Virginia Beach, Va., Sept. 14-16. Sec., Edward H. Ruehl, R. Stuart Royer & Assoc., 15 W. Cary St., Richmond, Va.

National Conference for County Engineers and Officials
Annual Meeting, Biltmore Hotel, Atlanta, Ga., Sept. 19-21. Dir., Ben F. Ostergren, County Div., ARBA, 600 World Center Bldg., Washington 6, D. C.

Water Pollution Control Federation (Formerly the Federation of Sewage & Industrial Wastes Assoc.)
The Trade & Convention Center, Philadelphia, Pa., Oct. 2-6. Exec. Sec., Ralph E. Fuhrman, 4435 Wisconsin Ave., N. W., Washington 16, D. C.

19th Annual Short Course on Roadside Development
State Office Bldg., Columbus, Ohio, Oct. 4-7. Wilbur J. Garmhausen, State of Ohio, Dept. of Highways, Columbus 15, Ohio.

American Public Health Assoc.
Civic Auditorium, San Francisco, Calif. Oct. 31-Nov. 4. Exec. Dir., Dr. Berwyn F. Mattison, 1790 Broadway, N. Y. 19, N. Y.

American Bridge, Tunnel and Turnpike Assoc., Inc.
Sheraton-Atlantic Hotel, New York, N. Y., Nov. 14-17. Exec. Sec., J. Allyn Stearns, Northcourt Bldg., 175 Main St., White Plains, N. Y.

American Road Builders' Assoc.
Chalfonte-Haddon Hall, Atlantic City, N. J., Mar. 5-8, 1961. Vice Pres., Louis W. Prentiss, 600 World Center Bldg., Washington 6, D. C.

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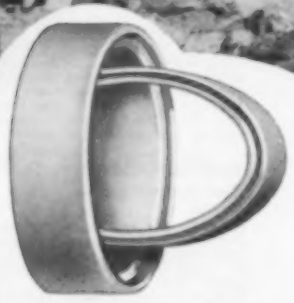
for lasting service at low cost

American-Marietta offers concrete manholes and a variety of pipe styles—each precast for faster installation at less cost—each designed to do a specific job better. A-M Concrete Products plants are strategically located throughout the country to assure quick delivery. Write for the name of the plant nearest you and ask for free literature on any of the products illustrated below.

HI-HED® PIPE

Saves trench width in congested areas



INNER CIRCLES®

Minimizes surface excavations, makes salvaging of old sewers easier

LO-HED® PIPE

Minimum depth of cut—affords increased cushion of cover

CONCRETE PIPE

Strengths pretested to eliminate guesswork

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CONCRETE PRODUCTS DIVISION

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AMERICAN-MARIETTA BUILDING
101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS. PHONE: WHITEHALL 4-5400

To order these helpful booklets check the reply card opposite page 34.

NEW LISTINGS (Cont.)

Bring Yourself Up-to-date on Tractors and Mowers

102. Three new brochures are now ready to do that for you. Color-illustrated, fact-packed and with a time-saving manner of presenting what you may want to know. Get Forms 1-1060A, 1-1070 and A1236 from The Oliver Corp., 400 W. Madison St., Chicago 6, Ill., or circle our card-number.

Few Are Born Knowing How to Do Traffic Marking

103. But those equipped with this new brochure soon learn all the best ways. Here in a color-illustrated booklet are all essential facts about this live subject. It is free on your request of Trafficaide Corp., Auburn, N. Y., or just circle the inquiry card.

Use The Reply Card

Foil The Kids with the Rocks

106. Even rifle bullets fail to shatter this new type fiber glass street light globe. Fits all major models of popular luminaires. New folder tells of savings possible, why these globes excel and how to order. Get yours from Commercial Products Div., Plastic Age Sales, Inc., 14300 Davenport Road, Mint Canyon, Calif., or by circling our card-number above.

You Can Avoid Over-Specialization

134. . . . in a highway maintainer by ordering this new bulletin describing an All-Purpose Maintainer with hydraulically controlled attachments ranging from bulldozer and broom to patch roller, mower and snow plow. Has torque converter and many special features. Just write for Bulletin HWM-512 to Huber-Warco Co., P. O. Box 501, Marion, O., or check the number above on our card.

Calcium Chloride Handling and Storing a Problem?

107. There's help, then, in this new book written especially for highway engineers and contractors. Winter maintenance gets a whole special section in it, too. For free copy of Manual HM-1 write Calcium Chloride Institute, 909 Ring Bldg., Washington 6, D. C., or circle the reply card.

Hand Reference on Centrifugal Pumps

115. Basic pump models, closed or open impeller and self priming solids handling series with models up to 8" size are presented in Form 9-IP-11 of Gorman-Rupp Co., 305 Bowman St., Mansfield, Ohio. Performance curves and lists of features make this a useful reference. For yours, check the inquiry card.

The Brush Chipper With Ten Exclusive Advantages

128. Brush chipper features worth investigation are described in Mitts & Merrill Catalog 460. Advantages include ability to cut two sizes of chips. Catalog illustrates uses and gives specifications of "Beaver" Chipper. For your copy, write Mitts & Merrill, 1009 S. Water St., Saginaw, Mich., or check reply card.

Do You Know ALL About Meter Settings?

132. If not, this new book will not only surprise you but help you with its wealth of information. It is a comprehensive treatise on a subject commonly ignored in textbooks. Any water works man can profit by having it. To get yours, just write The Ford Meter Box Co., Wabash, Ind., or circle number on inquiry card.

Lubricating Equipment for Public Works Garages

133. Complete line, every possible type of lubrication equipment described in three comprehensive booklets. Check the latest equipment and methods by getting Catalogs 222, 105 and 301 from The Aro Equipment Corp., Bryan, Ohio. Check the inquiry card.

Controlling Water in Masonry

135. . . . confronts and puzzles practically every building owner, designer or builder. There is still no "wonder drug" cure-all, but a very valuable 44-page booklet is available that goes farther in diagnosis and suggested remedies than anything we have yet seen. Your copy of "Walls Breathe" can be had from Western Waterproofing Co., 1223 Syndicate Trust Bldg., St. Louis 1, Mo. Or if you check our card number it will be sent you.

Odor Control Treatments for Sewage Plants and Storm Sewers

137. Poly-cide odor control treatments have been successfully used by municipalities in eliminating obnoxious odors from sewage plants, storm sewers, garbage and rubbish trucks, refuse cans and public rest rooms. Write Brooks Chemicals, Inc., 3304 E. 87th St., Cleveland 27, Ohio, or check the reply card for literature.

Heavy-Duty, Non-Volatile Brush and Vegetation Killer

139. Quick acting, complete kill and no drifting Fence Fire kills all brush and weeds with one gallon making up to 100 gallons of spray. Write The Gledhill Road Machinery Co., Galion, Ohio.

Elliptical Concrete Pipe for Sewers and Culverts

143. A 4-page bulletin is available from United States Concrete Pipe Co., 1500 Union Commerce Bldg., Cleveland 14, Ohio, on the use of elliptical pipe to obtain round pipe flow equivalents in certain areas. Check the reply card for diagrams, data charts and tables that fully describe elliptical pipe sizes and compute discharge flow rates for the full range of pipe sizes.

Radius Wall Forming—

147. How to do it faster and better with plywood concreting forms is the theme of a facts-and-figures booklet just out. Includes data on metal corner guards that prolong life of forms. For your copy write Gates & Sons, Inc., 80 So. Galapago Street, Denver 23, Colo. Or just check our card at this number.

KOEHRING

Performance reports from Skooper owners prove . .

400 tons an hour with only 64 hp

OHIO — Koehring 205 Skooper with 2½-yard rehandling bucket was clocked loading from stockpile into trucks. Time studies showed production rate of approximately 400 tons an hour with the 64 hp machine! Discharge height: 12'-10" at beginning of dump, over 10' after dumping.

Macadam breakout easy with SKOOPER

LOUISIANA — On street resurfacing, old pavement was peeled off, loaded out by Skooper alone. No preliminary ripping or breaking. Powerful 7-foot level crowd action coupled with tremendous hydraulic break-out force enabled the operator to maintain grade, held grader work to minimum.

To order these helpful booklets check the reply card opposite page 34.

A Handy List on "In Stock" Pipe

148. . . . is issued monthly by L. B. Foster Co. to show all stock footages of seamless and welded pipe, structural steel pipe and other specialties. Enables you to order pipe with exact knowledge of what is immediately available. Address L. B. Foster Co., P. O. Box 1647, Pittsburgh 30, Pa., or you can just check number on our card.

Everything You Want to Know About Rambler Compact Cars

149. . . . is in the new Fleet Presentation Manual of these cars as now advertised in Public Works. A work of art and a mine of valuable information, all yours by writing Fleet Sales Dept., American Motors Corporation, 14250 Plymouth Road, Detroit 32, Mich. Or you can just circle number on our card herewith.

Chain That Pays For Itself

134. Aluminum chain for protective barriers for roads, parking lots and work areas, and as guard rails inside water, sewerage and electric plants, pays for itself by eliminating maintenance. For specification folder, price list and sample links, address Bison Aluminum Chain Co., Inc., Dept. C-P, 249 Hertel Ave., Buffalo 7, N. Y., or circle number on card.

To Sweep a Better Street for Less

162. Find out about what Prostran can do to make your street sweeper brooms last longer, cut "down-time" and lower your cost per sweeping mile. A folder, with sample polypropylene filament is yours for the asking from E. B. & A. C. Whiting Co., Burlington, Vermont, or circle the number on our card.

Transite Pipe For Sewer Mains

144. Johns-Manville "Transite" Sewer Pipe, made of asbestos-cement, is available in 11 different diameters ranging from 6" to 36" and in five new crushing strengths to permit greater efficiency in system design. "Ring-Tite" Coupling, designed for high-speed assembly, provides tight, long-lasting seal. Easy-to-assemble Transite sewer fittings also furnished. For complete information, write for brochure TR-165A (Transite Sewer Pipe), TR-94A (Sewer Design Flow Chart), and DS-366 (Transite Material Specification). Johns-Manville, 22 East 40th St., New York 16, N.Y. Check reply card.

There's Far More Than Meets the Eye in Cyclone Fence

168. Get the full story of all that this fencing is and what it can do for you around expressways, reservoirs, sewage works, pumping plants, incinerators, landfills, recreation areas, storage yards and the many other places where public works need protection. Address Cyclone Fence, American Steel & Wire, 614 Superior Ave., N.W., Cleveland 13, Ohio; or circle the number on this card.

STREET LIGHTING AND TRAFFIC CONTROL

Put Traffic Signals Out Where They Can be Seen

686. A 20-page booklet points out how to do this most effectively, gives fullest detail. Follow it and more motorists will love you. As first step, ask for Catalog TE-1 of Pfaff & Kendall, 84 Foundry St., Newark 5, N. J., or circle number on our card.

Where to Get Those Indispensable Traffic Cones

663. Why you need them, where they are most useful, with full descriptions and dimensions. Rubber or plastic, with or without adapters, flasher lights and flags. Just write for attractive four-color bulletin to Radiator Specialty Co., 1400 W. Independence Blvd., Charlotte 8, N. C., or circle above number on card.

SNOW AND ICE CONTROL

Uniform Salt Spreading Saves Material

42. The wide, thin pattern provided by Tarco "Scotchman" spreaders avoids salt waste, saves time and labor. Get Folder BL for full details on their spreader and table of material application rates. Use reply card or write Tarrant Mfg. Co., Dept. PW, Saratoga Springs, N. Y.

Catalog on Tractor-Driven Tailgate Spreader

182. Highway Equipment spreader spreads in the echelon pattern for ice control and the blanket pattern for seal coating. For literature write Highway Equipment Co., Dept. H41 616D Ave. N. W., Cedar Rapids, Iowa.

Save on Winter Ice Control Cost

237. . . . with the faster-working salt described in this new Bulletin B-1159S. Tells what this salt will do and why, and where to get it. Also the bonus you get from using salt for summer road stabilization projects. Address Morton Salt Co., Industrial Div., 110 N. Wacker Drive, Chicago 6, Ill., or use our card.

BUSINESS ADMINISTRATION

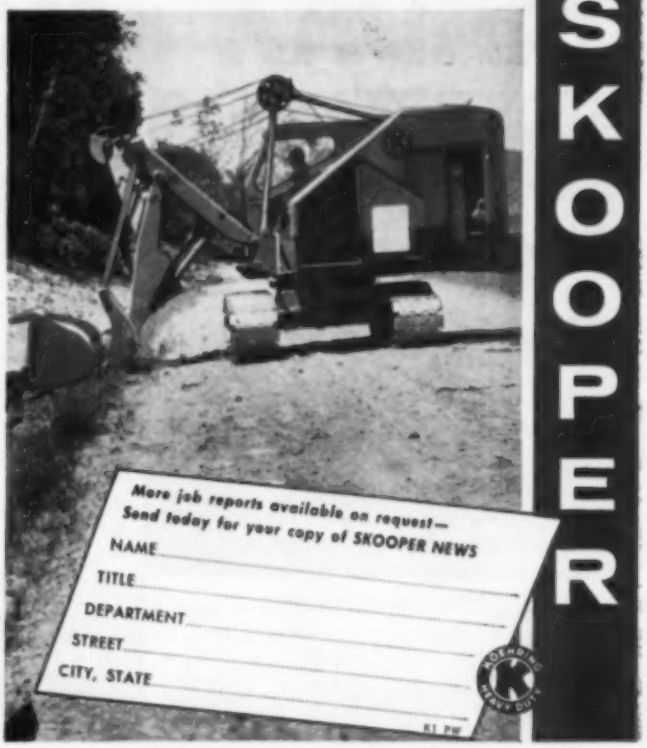
Monthly Time and Cost Record Book

249. To assist owners in determining the cost of owning and operating equipment Caterpillar Tractor Co., News Service, Peoria, Ill., has prepared a 24-page monthly time and cost record book. Twelve sets of pages are included on which to record day by day machine expenses for an entire year. Check the reply card for your copy.

. . there's nothing like it — on wheels or tracks!

Take the full-revolving swing of a shovel, add the big bucket capacity and versatility of a tractor loader, and what do you have? *A new concept in speed loading* — with none of the usual drive-in, back-out waste motion of front-end loaders, none of the high tire or track maintenance of skid-turn operation. Skooper swings through continuous dig-swing-dump-return cycles without traveling — crowds 2-yard bucket along 7-foot level clean-up from "stand-still" position. Result: more versatility, more output, at substantial savings in fuel and maintenance costs. That's not all! Standard shovel-hoe-crane attachments make Skooper a doubly-sound investment for your carefully-budgeted dollars. Call Koehring® distributor, or write us for full details.

KOEHRING
DIVISION OF KOEHRING COMPANY
3026 W. Concordia, Milwaukee 16, Wis.



Keeps traffic open during clean-up

KENTUCKY — Highway department's Skooper cleans ditches, trims shoulders, banks, clears rock slides — stays in one lane, keeps other lane open to traffic. Skooper bucket reaches below the grade, above the grade, crowds straight ahead, or cuts at any angle of the bank slope.

To order these helpful booklets check the reply card opposite page 34.

REFUSE COLLECTION AND DISPOSAL

Where Does It Go From Here?

63. That is the title of new 12-page booklet, D 930, with thorough discussion of garbage disposal by sanitary landfill method. Read the latest report from the experts. Caterpillar Tractor Co., Peoria, Ill., or check card.

Increase Your Refuse Collection Efficiency by 20 Percent

123. New principles and features like continuous loading, pre-crushing of refuse, bigger collections per load, safer operation, lower maintenance, faster collections are all described in new Catalog Section 5a. Write for it to Daybrook Hydraulic Div., Bowling Green, Ohio, or—easier—just circle our card-number.

Load-Packer 600 Points the Way to the Best in Refuse Collection

188. Bulletins W-200, W-220 and W-221 explain how the Gar Wood Load-Packer gives faster operation, bigger payload, more compaction, a larger hopper and more dependable operation. Write Gar Wood Industries, Inc., Wayne, Mich., or check the reply card for full details.

Literature Describes M-B Contain-O-Pack System

190. A 6-page catalog describing the M-b Contain-O-Pack, a complete low cost containerized refuse system for private haulers and municipalities is available from M-B Corp., New Holstein, Wisc. Check the reply card.

How to Construct A Sanitary Fill

331. A new 12-page booklet which tells the most efficient method of sanitary fill construction and furnishes complete information on planning and operation is now available from Drott Mfg. Corp., Milwaukee 15, Wis. Get your copy by checking the reply card: you'll find this booklet both interesting and valuable.

Make Molehills out of Your Refuse Mountains

94. New and better ways of refuse and garbage collection and handling are described in newest literature on collection systems employing giant containers, bodies and trailers that speed your work, cut costs, improve sanitation. Adaptable to small cities as well as large. Write Dempster Brothers, Dept. PW, Knoxville 17, Tenn., or circle the number on our card.

WEED CONTROL

How to Cut Weed Control Costs

308. Information on a weed killer that can save hundreds of man-hours of clearing and cutting is available from Diamond Alkali Co., 300 Union Commerce Bldg., Cleveland 14, Ohio. Whether you want to control weeds or brush or both, without damage to crops or ornamentals, get this literature today by checking the reply card.

RECREATION

How to Equip Your Parks and Playgrounds

414. A handsome 60-page illustrated catalog showing a full line of extra heavy duty playground, park picnic and dressing room equipment, plus many related items, is now available from American Playground Device Co., Anderson, Ind. Complete specifications, construction features, prices and details of labor and materials needed for installation are included. Check the reply card.

CONSTRUCTION EQUIPMENT AND MATERIALS

To Keep You Up-to-Date . . .

22. On tractor loaders, motor graders and tractor shovels, Allis-Chalmers keeps bringing out new literature that is well worth your while. Ask them for it, specifying where your interest lies. Write Allis-Chalmers Mfg. Co., Tractor Group, Box 512, Milwaukee 1, Wis. or circle our card.

International Wagner Heavy-Duty Loaders and Backhoes

195. International Wagner loaders and backhoes are matched with International utility tractors and are described in Catalog CR-1076-I available from International Harvester Co., Consumer Relations Dept., 180 N. Michigan Ave., Chicago 1, Ill. Check the reply card.

Booklet Shows Design of Pre-Engineered Steel Buildings

271. Pre-engineered Butler steel buildings are available in every size, type and design to meet your building needs. In a helpful four color booklet you will find details on several basic designs for community use; answers to your questions on construction and erection; and many illustrations of typical uses. Write to Butler Mfg. Co. 7321 East 13th St., Kansas City, Mo.

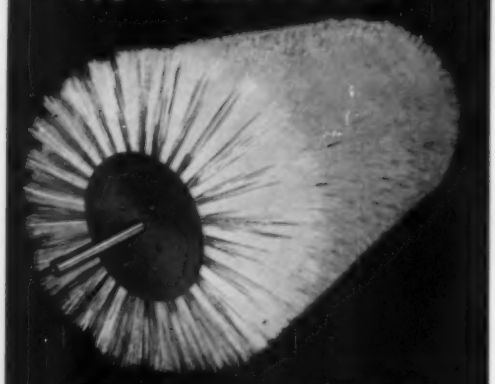
The Principles of Compaction by Vibration

288. Compaction specifications that can't be met with ordinary compactors are no problem to the new Essick vibrating rollers. Complete descriptive literature explaining the principles of compaction by vibration and the Essick vibrating roller is available from Essick Mfg. Co., 1950 Santa Fe Ave., Los Angeles, Calif.

RADAX®

A TRULY NEW CONCEPT IN PREFABRICATED Street Sweeper Brooms

NO CORES TO BUY!



filled with long wearing water repellant SR Plastic Filament or Tynex Nylon.

STEP UP to long-wearing, PREFABRICATED Plastic Brooms without making a capital investment. Get the lowest broom cost per mile you have ever experienced — with a NEW BROOM that really sweeps clean.

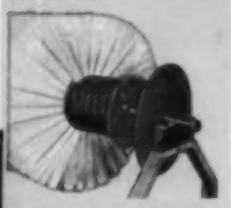
- NO CORES TO BUY
- NO CHANGES IN PRESENT EQUIPMENT
- TRUE BALANCE AND UNIFORMITY THROUGHOUT

RADAX units are made on high-speed fully automatic machines. The cost factor is held down to an absolute minimum.

ONE — TWO — THREE and GO

1. Remove your stretchy broom cable.
2. Screw on the RADAX unit.
   (Visualize the RADAX Broom Coil as a big nut and your broom core as a threaded bolt. The RADAX unit screws on like putting a nut on a bolt.)
3. Anchor coil ends (we furnish anchor fixtures) and you are ready to go!

Filaments are grouped into tufts — bound in steel channel and formed into the unique continuous one-piece RADAX Coil.



Screw the RADAX Broom Coil onto the old core — anchor — it's ready to go!

PRICES — delivered to your shop

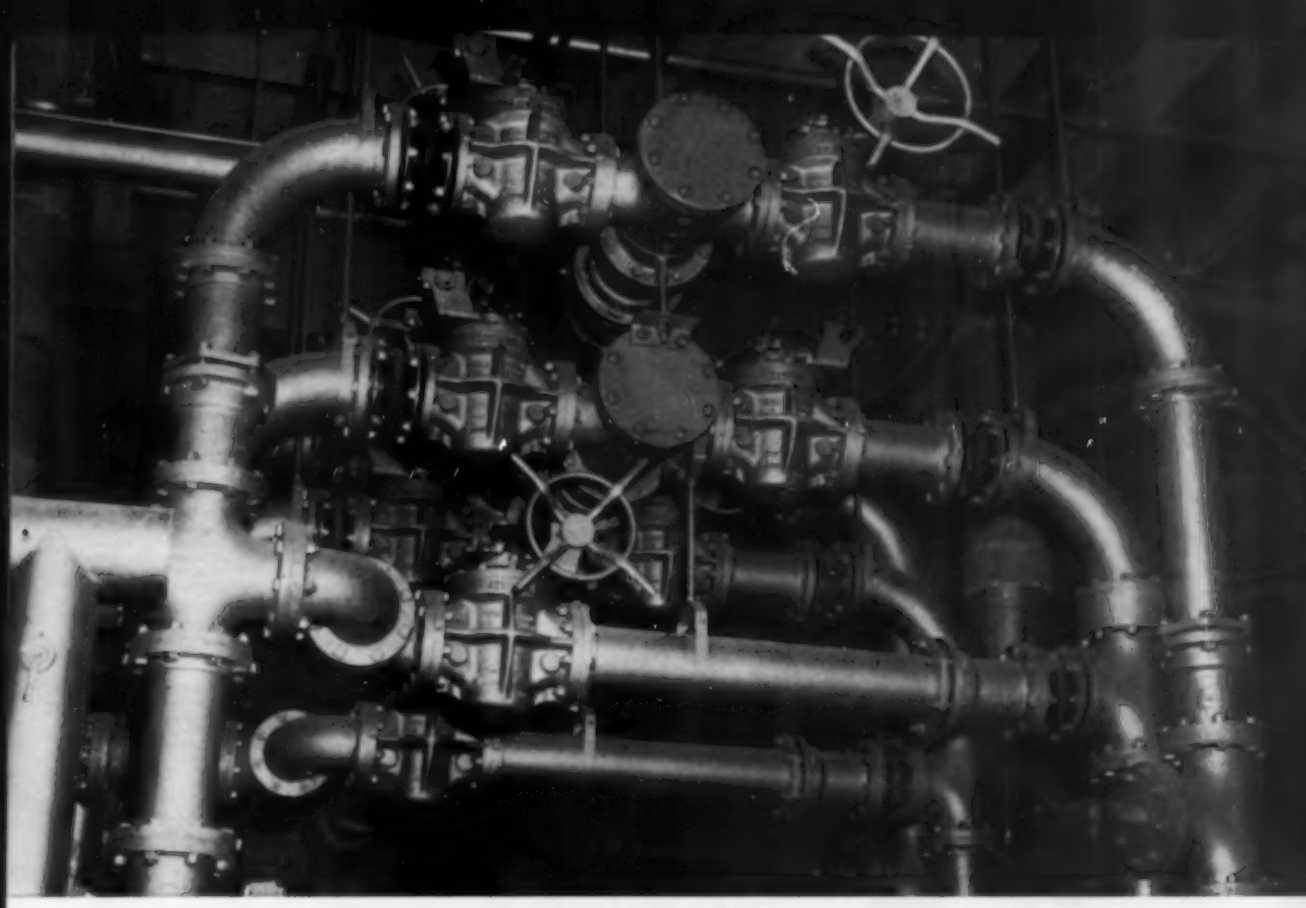
SWEEPER MAKE and MODEL	SR FILAMENT	TYNEX NYLON
MOBILE 54" BROOM	$195.85	$293.15
MOBILE 58" BROOM	$208.30	$310.60
WAYNE 450, 460 and 550	$169.75	$252.50
ELGIN STREET KING	$258.20	$388.10
ELGIN WHITE WING	$258.20	$388.10

The RADAX Unit is disposable when worn out. Nothing to return for refilling.

RYNAL CORPORATION

DEPT. B, 114 ST. JOSEPH ST.

ARCADIA, CALIFORNIA • HI 6-3600



CUT YOUR TOTAL VALVE COSTS WITH LUBRICATED PLUG VALVES

For sump discharge, supernatant lines and other wastes services, many large sewage disposal plants have standardized on Rockwell-Nordstrom valves for dependable flow control at lowest overall cost. The simple construction of these rugged *lubricated* valves minimizes maintenance problems—only three basic parts: plug, body and cover. Lubricant also forms a leakproof seal for positive shutoff on heaviest sludge or lightest gas, and vital seating surfaces are always protected from erosive-corrosive line material. You'll get faster, more efficient power operation, too, because these valves are fully closed with just a quarter-turn of the *lubricated* plug—sizes ½" to 36"; pressure ratings to meet your needs. For complete information on Rockwell-Nordstrom's complete line of lubricated plug valves and operating accessories, write Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

Lubrication Makes the Difference

ROCKWELL-Nordstrom VALVES

another fine product by

ROCKWELL

Rockwell Manufacturing Company
Department 173G
Pittsburgh 8, Pennsylvania

Please send me Bulletin C-5200.

Please have your sales engineer call.

Name_____ Title_____

Address_____

City_____ Zone_____ State_____

This Expansion Bolt Will Let You Sleep Nights

279. When you anchor the smallest fixture or the heaviest machinery in concrete, masonry or any non-frangible material with Wej-it bolts they stay anchored. Catalog with details and specifications, free from Kirel Inc., Kingston, N. Y., or circle our card number.

Hydra-Drives Power Shift Transmissions

283. With four speeds forward and reverse, the Hydra-Drives is ideally suited for vehicles which must travel in both directions during a normal work cycle. Check the reply card or write Rockwell-Standard Corp., Transmission and Axle Div., Detroit 32, Mich., for full details.

Why and How To Use Pneumatic Tired Rollers

299. The why and how of pneumatic tired rollers on base and surface courses, sealing completed fills, surface treatments, floated surfaces, hot and cold asphalts and stabilized soils are covered in Bulletin 10 from Tampo Mfg. Co., San Antonio, Tex. For information on operating conditions and compaction charts check the reply card.

Complete Line of Shovels, Draglines, Cranes and Clamshells

361. Bucyrus-Erie crane-excavators in sizes from ½ to 4 cu. yd. capacities are covered in literature from Bucyrus-Erie Co., South Milwaukee, Wis.

Complete Bulletin On Municipal Supplies

473. Everything from leak locators to street signs is listed in the big 100 page bulletin "Municipal Supplies" published by Darley. Hundreds of different items for all city departments are included. Get your copy of Bulletin No. 155 from W. S. Darley & Co., 2814 Washington Blvd., Chicago 12, Ill.

When You Roll, Roll Right

339. . . . with these Galion Roll-O-Matic tandems. Eight page catalog details advantages and includes complete specifications and compression data. Ask for Catalog 425 direct of The Galion Iron Works & Mfg. Co., Galion, Ohio, or circle above number on reply card.

To Increase Your Public Works Efficiency

561. Ask now for the new "Modern Methods and Equipment" booklet that spells out how other officials have applied IH equipment to everything from earth moving and ttrenching, from snow plowing and road building to pipe laying and electric power plants. Write International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., or check our caard.

Complete Line of Asphalt Patching Mixers

586. Mixers capable of mixing 3 to 20 tons of hot mix per hour are described in literature available from McConnaughay Mixers, Inc., Lafayette, Ind. Check the reply card for full information on patching, repairing, resurfacing and sealing.

A Completely Hydraulic Ladder

610. This completely hydraulic ladder is described in a new catalog published by J. H. Holan Corp., 4100 West 150th St., Cleveland 11, Ohio. Detailed drawing of the pedestals, throttle control and ladder construction are included.

Attachments For Ford Tractors

643. Clearing, backfilling, ditching, excavating, mowing, scarifying, sweeping, and trenching equipment are a few of the attachments described in literature from Tractor and Implement Div., Ford Motor Co., 2500 East Maple Road, Birmingham, Mich.

buried

The pipe you select must do the job under all conditions

©1960—U.S. Industries, Inc., Arusa, Calif.

SP-5-60

To order these helpful booklets check the reply card opposite page 34.

STREETS AND HIGHWAYS

Save One Man's Labor

29. With the new Wylie ROADMASTER self-contained asphalt plant, specifically designed for municipalities. New illustrated brochure tells all in 8 attractive pages. Write for it to Wylie Mfg. Co., Box 7086, Oklahoma City 12, Okla., or check the card.

Foundation Investigation and Pressure Grouting

48. Foundation investigation and pressure grouting and the various miscellaneous services of Sprague & Henwood are described and illustrated in literature from Sprague & Henwood, Inc., Scranton 2, Pa.

Don't Stand There Figuring!

51. Use the new Forney PSI Calculator "slide rule" for concrete products that includes instant conversion data from total load to psi on 17 standard test specimens and masonry units. Pocket size. Free. Address Forney's Inc., Tester Div., Box 310, New Castle, Pa.

400 Tons an Hour With Only 64 Hp . . .

100. That's just one report on the Koehring "Skooper" which is combining the full-revolving swing of a shovel with the big bucket capacity and versatility of a tractor loader, giving a new concept in speed loading. Cuts costs at every turn. Address Koehring Div., 3026 W. Concordia, Milwaukee 16, Wis.

Davis Backhoe Has Hydra-Slide Positioning

189. It is possible for one man to move the entire digging assembly along the frame to any of the five positions in less than five minutes. Full details from Massey-Ferguson Industrial Div., 1009 South West St., Wichita, Kans. Check the reply card.

Illustrated Specifications on Brush and Limb Disposal

222. A new booklet on the modern approach to the brush problem shows how an Asplundh chipper reduces bulky branches and brush trimmings to chip size for mulch or easy removal. Write Asplundh Chipper Company, 501 York Road, Jenkintown, Pa., or use the handy reply card.

Rubber Roads Are Now a Reality

230. Ramflex, a free-flowing, devulcanized rubber specially prepared to be used in combination with asphalt for highway paving applications is described in illustrated catalog from U. S. Rubber Reclaiming Co., Inc., P. O. Box 365, Buffalo 5, N. Y. Check the reply card.

How to Solve the Brush Disposal Problem

277. Fitchburg Chippers, engineered to solve the brush disposal problem reduce troublesome brush and trimmings to tiny, easy to-dispose-of chips. Several models are available to meet your needs. May be mounted on truck body or on trailer, tractor or jeep. Full details in interesting, profusely illustrated 16 page bulletin. Write Fitchburg Engineering Corp., Fitchburg, Mass.

Tractor-Shovels With Drott "Four-In-One" Attachment

352. Hough rubber-tired front-end loaders come equipped with the Drott "4-in-1" bucket. Check the reply card or write The Frank G. Hough Co., Libertyville, Ill., for literature on how to use this unit as a shovel, clamshell, scraper and bulldozer.

New Methods and Materials For Mounting Sweeper Brooms

393. Simplified core filling with long lasting plastic filaments is described in fact sheet. Write Rynal Corporation, 114 St. Joseph St., Arcadia, Calif., or check the reply card.

Self-Propelled Ditching Machines

438. Information on a self-propelled one man operated ditching machine, model 524 T, model W-2 and a new midget ditcher, model 4 T, for light construction is now available from the Vermeer Mfg. Co., Pella, Iowa. The Model 524 T digs 8 to 24 inches wide and down to 6 feet deep, while the model 4 T digs 6 to 14 inches wide and down to 4½ feet deep. Model W-2 Ditcher digs from 2" wide up to 4" down to a depth of 30". Full data on these ditchers available by checking the reply card.

Pavement Sealer Protects and Preserves Asphalt Pavement

450. Parking lots, airfield runways, driveways and playground areas are places where Koppers pavement sealer can be used. Check the reply card or write Koppers Co., Inc., Tar Products Div., Pittsburgh 19, Pa., for data on this easy to apply sealer.

Even Skunks Envy These White Lines

487. . . . as put down on pavements by Mark-Rite striping machines. A type for every job—one, two or three lines, one or two colors. For full data on these versatile machines get catalog from Unimasco, Inc., 426 W. Redondo Beach Blvd., Gardena, Calif., or check the card.

For Better Work All Over Town

525. Put a Bantam in your life. On trenching, excavating, street and highway work this handy versatile crane-excavator obviates using larger equipment in many cases. Saves time and dollars. Get descriptive literature from Schield Bantam Co., 301 Park St., Waverly, Iowa or circle card-number.

Cushman Truckster Delivers Greatest Light Hauling Economy

636. Complete information on the Cushman Truckster is available from Cushman Motors, 900 No. 21st, Lincoln, Nebr. Features are choice of body styles, formed channel chasis, constant mesh transmission and hydraulic brakes, 12-volt lighting system, etc.

OREGON WASHOUT
A case where floods left steel water line spanning a 50-ft. wide ditch. Line did not fail. Steel pipe continued to carry its own weight and that of water it was transmitting. Southern Pipe Steelcor Products—such as CEMCOTE, mortar lined and coated steel water pipe—are the only products with the hi-beam strength of steel to withstand such tests.

YUMA TERRAIN
A case where rocky terrain and access problems made pipe laying extremely difficult. A select backfill of sand could not be used in ditch. Danger of rupture from settling was obvious. Southern Pipe's own Steelcor product—CEMCOTE, cement mortar lined and coated steel water pipe—was easily handled and laid. Continues to perform.

RIDGE ROUTE TRAFFIC
A case where truck traffic overhead presented serious vibration problems. Steel's inherent resiliency and strength proved the answer. Unlike rigid pipe, steel transmits strain to surrounding soil. Southern Pipe Steelcor Products—a complete line of lined and coated steel water pipe—provide this performance.

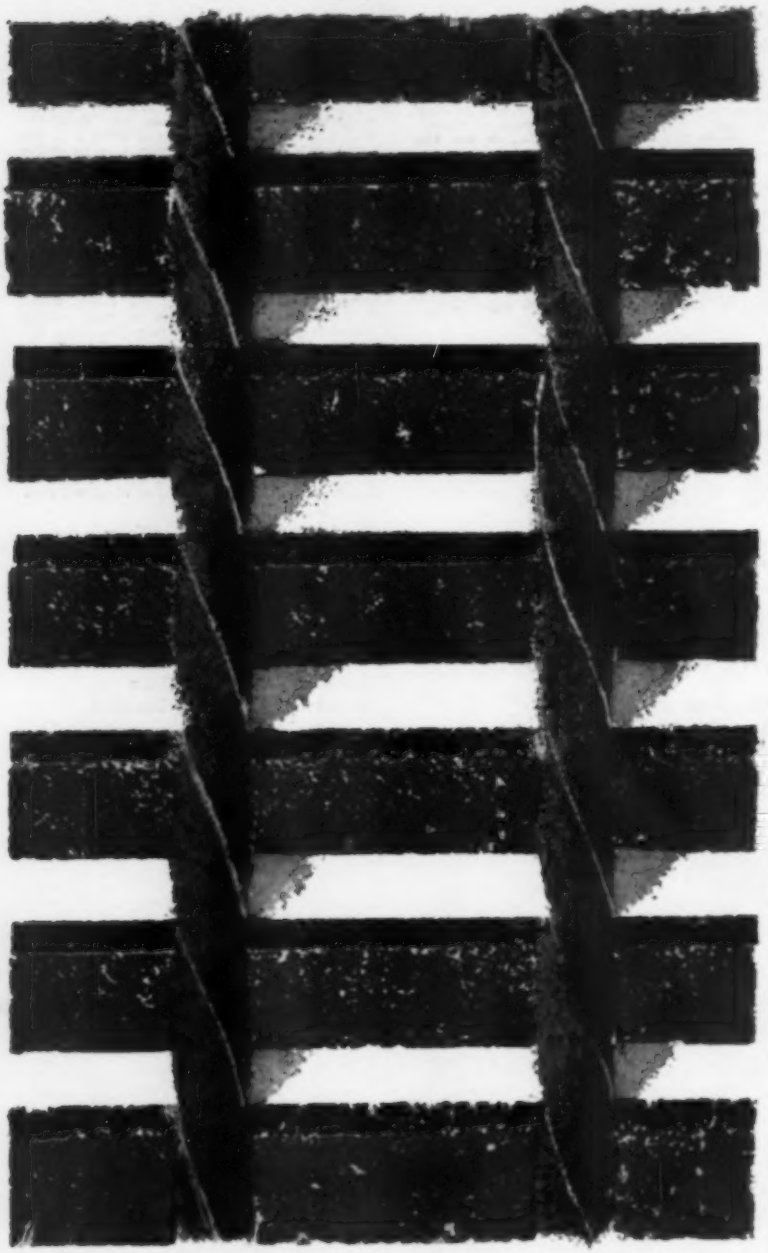
TEHACHIPI QUAKE
A case of earthquake with tragic consequences where no other pipe stood up like steel water pipe. Under such emergency conditions steel does the best job; joints don't leak; pipe gives with soil movement. Southern Pipe can help you specify the proper lined and coated steel water pipe to meet all your long-range needs.

USI

Southern Pipe

DIVISION OF U. S. INDUSTRIES, INC.
P. O. Box C, Azusa, California • CU 3-7111
P. O. Box 1323, Honolulu, Hawaii • 28-5757

To order these helpful booklets check the reply card opposite page 34.



Blaw-Knox Electroforged Grating solves so many problems for so many industries. Catalog free on request. Write

Blaw-Knox Equipment Division, Pittsburgh 38, Pennsylvania.

BLAW-KNOX
GRATING

No Idle Trucks with these Spreaders

397. New 8-page catalog gives features, specifications, users' statements on the Fox Mountable spreaders, equally good for sand, cinders, chips, salt, calcium chloride. Designed for one-man operation and year-round use. Wide widths and high speeds. Mounts or demounts in 15 minutes. Write Fox River Tractor Co., Box 469, Appleton, Wisc., or check our card number.

64-Page Manual On Surface Treatments

484. Complete up-to-the-minute information on all types of surface treatments is covered in manual available from American Bitumuls & Asphalt Co., 320 Market St., San Francisco 20, Calif. The Manual provides on-job reference as well as engineering department use and it covers every step from pavement inspection to traffic-control on the finished pavement. Check the reply card.

Vacuum Cleaner and Leaf Collector For Cleaner Streets

595. A unit is now available that can be mounted on a right-hand drive jeep or a pick-up truck for picking up gutter trash and leaves. Complete specifications, capacity, operation and installation procedures are covered in a bulletin available from Tarrant Mfg. Co., Saratoga Springs, N. Y.

Here's a King-Sized Sucker-Upper . . .

656. . . . that will rid your streets and gutters of leaves, litter and other bulky materials in record time. Cleans catch basins to 8-ft. depth in minutes. Bulletin PL 758 S describes and illustrates this motorized Scavenger. Address Good Roads Machinery Corp., Minerva, Ohio, or circle number on card.

Make Your Concrete Defy the Seasons.

658. A new pocket-size booklet describes and illustrates all the good things Wyandotte Calcium Chloride can do for your concreting in faster hardening, high early strength, increased final strength and workability—to name but a few. Get your copy from Wyandotte Chemicals Corp., Wyandotte, Mich., or circle the number above.

Construction Guide For Engineers and Builders

669. A 24-page four sectioned construction guide containing full-page structural drawings that provide basic information on types, grades and applications of fir plywood for engineers and builders has been released by Douglas Fir Plywood Association, Tacoma 2, Wash. Check the reply card for data on floor construction, single and double wall construction and roof construction.

Sweepers Handle A Variety of Jobs In Every Season

684. Mechanical drive one-way and pull type 2-way sweepers and hydraulic 2-way sweepers that are tractor-mounted or loader-mounted are fully covered in literature from M-B Corp., 1611 Wisconsin Ave., New Holstein, Wisc. Jobs like cleaning dust, dirt and snow from streets and highways and sweeping park lawns are a few of the sweepers applications. Check the reply card.

Spot the Loafers!

687. Servis Recorders do just that. Installed on street sweepers, dump trucks, refuse trucks and front loaders they make permanent tamper proof records of who and what is working and what is idle. Savings in fuel add to its economies. Write for "Off-the-Highway Bulletin," to The Service Recorder Co., 10158 Rockwell Ave., Cleveland 14, Ohio, or circle the above card number.

●

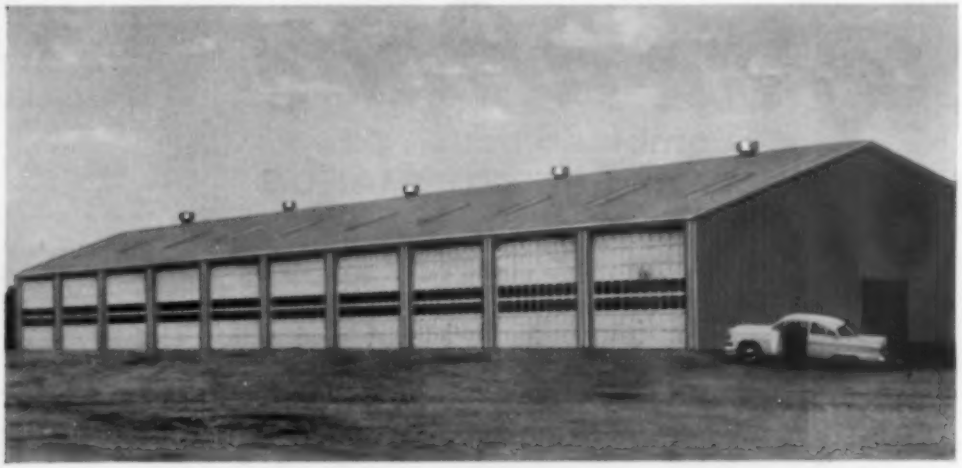
SEWERAGE AND WASTE TREATMENT

How to Make Better Sewer Pipe Joints

37. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston Co., Dept. P.W., Adams, Mass. Check the reply card.

NEUHARDT & BAAB—ARCHITECTS MIDLAND TEXAS

A BUTLER BUILDING EXCLUSIVE...CHOICE OF TWO SUPERIOR WALL PANELS IN COLOR



Buildings that don't tax your budget

...*pre-engineered by Butler*

Big or little . . . plain or fancy . . . there's a Butler pre-engineered building to meet the requirements of your community. These examples are typical of the hundreds of buildings throughout the United States that have been built by many progressive, cost-conscious communities. They all have three important advantages: Clear-span interiors that offer maximum use of inside space; load-bearing rigid frame structurals that permit complete freedom in construction and design of outside walls; and mass production economies that result in money-savings for the taxpayers.

Whether you need a "shirtsleeve" building for maintenance use or a "monument" with a handsomely designed exterior, there's a Butler building to fit your needs. And, metal buildings are not all alike! We invite you to compare Butler's two superior new wall systems with all others designed for pre-engineered structures . . . Butlerib, the new improved standard wall and roof panel, and Monopanl, the exclusive, factory-insulated curtain wall. You'll find they're the finest. Or, your Butler Builder will be happy to work with your architect in using a wide variety of curtain wall materials – such as glass, wood and brick.

Why settle for less than the best . . . build with Butler, the lowest cost way to build well. Before you build, call your Butler Builder. He's listed in the Yellow Pages under "Buildings" or "Steel Buildings."

BUTLER MANUFACTURING COMPANY

7321 East 13th Street, Kansas City 26, Missouri

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Manufacturers of Metal Buildings • Equipment for Farming, Oil Transportation, Outdoor Advertising • Contract Manufacturing

Sales offices in Los Angeles and Richmond, Calif. • Houston, Tex. • Birmingham, Ala. • Kansas City, Mo. • Minneapolis, Minn. Chicago, Ill. • Detroit, Mich. • Cleveland, Ohio • Pittsburgh, Pa. • New York City and Syracuse, N.Y. • Boston, Mass. Washington, D.C. • Burlington, Ontario, Canada

To order these helpful booklets check the reply card opposite page 34.

What You Should Know About Trickling Filter Underdrains

20. Specifications for vitrified clay under drain blocks conforming to ASTM standards, suggestions for layouts and construction of trickling filter floors, dimensions of standard blocks, channel covers, angles and other fittings are available from the Trickling Filter Floor Institute c/o Editor, Public Works, 200 So. Broad St., Ridgewood, N. J. Check the reply card and we will forward your request.

You Don't Need a Big Plant to Get Big Savings

21. . . . in mechanical sludge dewatering. Now the smaller plant can cut power costs, eliminate use of chemicals and reduce labor. 4-page bulletin on the "Roto-Plug" sewage sludge concentrator shows how this is accomplished. Write for Bulletin 100 to Nichols Engineering & Research Corp., 80 Pine St., New York 5, N. Y., or check the card-number.

Theory of Controlled Digestion With Floating Cover Tanks

88. In an excellent 40-page booklet, an authoritative discussion of digestion theory and practices, including design, operation and economics is presented by the Pacific Flush Tank Co., Chicago 13, Ill. Complete data are given on the use of floating covers, together with details on tank construction, piping and control chambers.

Protective Lining for Concrete Pipe and Structures

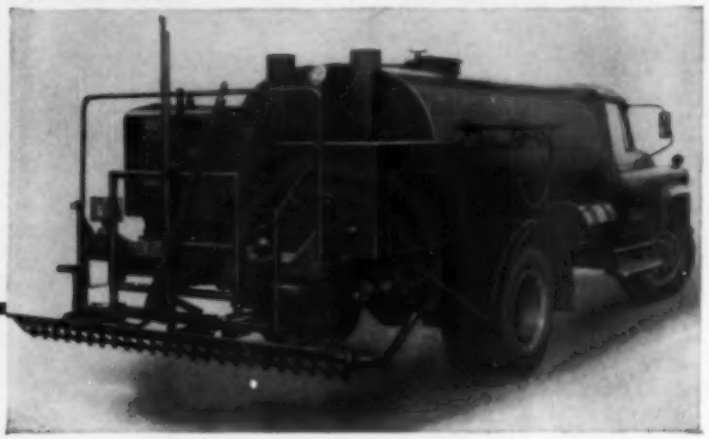
131. T-Lock Amer-Plate is a tough, long-lasting acid-resistant vinyl sheet lining for concrete pipe and structures which are exposed to corrosive materials. T-shaped ribs pressed in the sheet are embedded in the concrete as it is poured to lock the lining permanently in place. Get full details from Amercoat Corp., South Gate, Calif., or check the reply card for illustrated folder.

Standard Steel Model 658

Road-a-Mite

combines both

ECONOMY and PERFORMANCE



A Mighty Road-Builder with TODAY'S COMPACT CAR DESIGN!

On the working end of the Model 658 is a newly designed 12' full-circulating spray bar. Turn-up ends provide for additional sections up to 24' in length. Mechanical lateral shift and hydraulic vertical adjustment are standard.

The Model 658 provides the small community with equipment at a small investment so that they can more easily protect a larger investment in roads and streets. This compact new unit also provides the small city or beginning contractor with adequate means for blacktop construction work. The Model 658 provides low-cost secondary support to operators of the bigger pressure distributors.

Built to the Highest Standard

OTHER PRODUCTS OF STANDARD STEEL
ASPHALT DISTRIBUTORS . . . BURNERS . . . POWER AND TRACTION DRIVEN CONSTRUCTION BROOMS . . . MAINTENANCE DISTRIBUTORS . . . TAR KETTLES . . . AGGREGATE SPREADERS SHELVING HARDWARE . . PIPE LINE EQUIPMENT . . SUPPLY TANKS AND AGRICULTURAL EQUIPMENT

658-1

Standard Steel Works, Inc. NORTH KANSAS CITY MO

Stationary Engines For Sewage and Water Treatment Plants

82. Engines that operate on sewage gas, gasoline, butane or natural gas are described in literature from Climax Engine Mfg. Co., Div. of Waukesha Motor Co., Clinton, Iowa. Check the reply card.

A Short Course In Pipe Jointing

169. The story of rubber couplings for clay and concrete pipelines is graphically presented in the booklet "Pipe Enterprise", published by Hamilton Kent Mfg. Co., Kent, Ohio. Detailed description of pipe jointing methods; photos showing jobs where Tylox gaskets met the need for easily assembled permanently tight joints installed under all conditions; and a report on the development, manufacture and outstanding features of the compression type gasket make this booklet valuable to every engineer and contractor. Check the reply card.

How Are Your Bridge Floors?

185. If you face replacements—or plan new bridges—you will find much really helpful data on steel mesh bridge flooring, safety features, tractional surfaces, dimensions, weights, loads and spans in a new booklet offered by Irving Subway Grating Co., Inc., 50-09 27th St., Long Island City 1, N. Y. Includes detail drawings, specifications, also data on bridge sidewalks. Write for "Irvico Decking" booklet or circle

Get Data Now on This Catch Basin Cleaner

198. Simple powerful pneumatic bucket is featured by Neteo Catch Basin Cleaner. Folder 33A gives details and illustrates operation of complete self powered truck mounted unit, Neteo Div., Clark-Wilcox Co., 118 Western Ave., Boston 34, Mass. Check the reply card.

Incinerators for the Disposal of Combustible Wastes

217. Bulletin 179 from the Morse Boulger Inc., New York 17, N. Y. describes fully the basic principles of incineration as to combustion, auxiliary burners, draft and control and elimination of fly ash. Specifications and design of incinerators and hopper doors are included.

Turnkey Sewage Treatment Plant

239. Plants for smaller population areas that are furnished and installed on a turnkey basis are covered in literature from Municipal Service Company, 4625 Roanoke Parkway, Kansas city 12, Missouri. Check the reply card for your key to low cost sewage treatment.

Packaged Engineering Data on Packaged Lift Stations

235. Help on sewage pumping problems is available in new bulletins which cover packaged pump stations, pneumatic lift stations and pneumatic ejectors. Write to Tex-Vit Supply Co., Mfg. Div., Mineral Wells, Texas, or check the card.

Getting Improved Sludge Dewatering With Non-Clogging Vacuum Filters

425. Latest information on the Komline-Sanderson "Coilfilter," which features non-clogging, permanent filter media to obtain constant output and low operating cost is presented in illustrated Bulletin No. 106 by the Komline-Sanderson Engineering Corp., Peapack, N. J. Be sure to investigate this improved method of sludge dewatering. Check the reply card today.

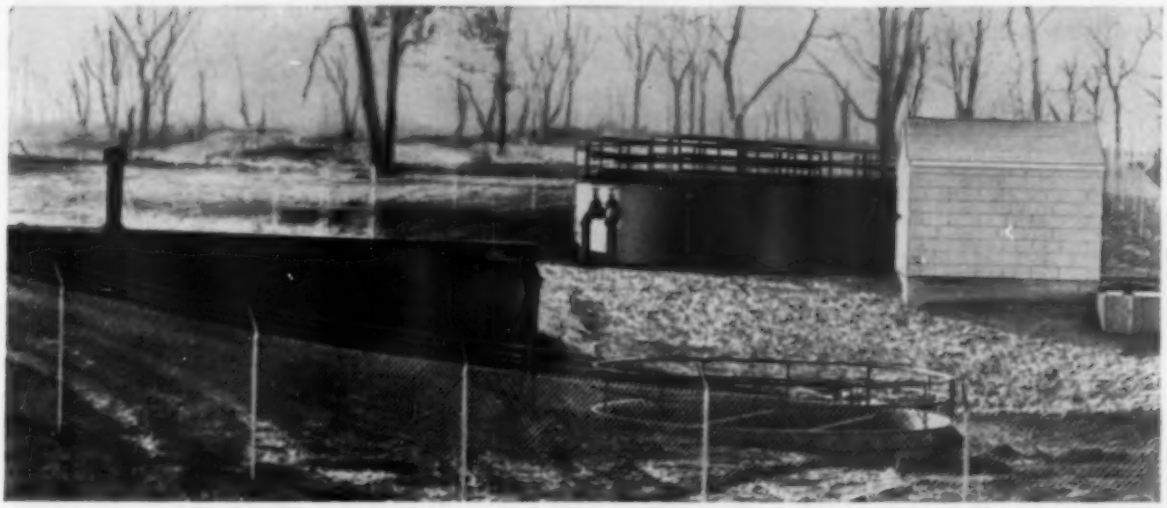
Manual on Construction Castings

462. This 168-page Manual covers catch basin inlets and traps, building castings, manhole covers and steps, flap valves, wheel guards, drainage grates and many other construction and maintenance castings. Check the reply card or write Neenah Foundry Co., Neenah, Wisc., for your copy.

Torque-Flow Sewage Pump For All Phases of Sewage Treatment

496. Bulletin No. P10-B26 describes the operation of the Wemco torque-flow sewage pump and covers typical installation set-ups. Check the reply card or write Western Machinery Co., 650 Fifth St., San Francisco, Calif., for complete details.

The Key to Low-Cost **Sewage Treatment** *Over All America* **"SUBURBIA"**



TYPICAL NORTHERN INSTALLATION, shown above, goes below-grade to take advantage of residual ground warmth during colder winters. This one serves 700 homes (245,000 gallons per day) in Gracemor Subdivision, Kansas City North, Missouri. Another northern installation, serving a 3,000-student branch of Michigan State University (and its new 700-home community) has recently been completed near Pontiac, Michigan.

TYPICAL SOUTHERN-STATES INSTALLATION, in lower photo, can go above-ground. Costs drop when tanks need not be buried, true of most of the South. This installation serves 300 homes (105,000 gallons per day) in the Corrine Terrace Development, Orange County, Florida. Another typical southern installation serves 118 homes (41,600 gallons per day) in the Debra Heights Development, St. Petersburg, Florida, with good, low-cost sewage treatment.

From the green hills of Michigan to Florida's Gulf Coast . . . from Eastern Seaboard cities across the plains of Kansas . . . to golden California. Bright new communities are rising over all America, made possible only through foresight on the part of developers, consulting engineers and public works officials.

For waste from these communities must be gathered, treated and disposed of – efficiently, and at low cost. This is the major reason why so many *thoughtful* people are investigating "Suburbia," the sewage treatment plant priced to fit fringe communities.

This new type of installation provides conventional sewage treatment for communities of 200 to more than 10,000 homes. Because each installation is planned and made under the direction of consulting engineers, "Suburbia" invariably conforms to state and local Department of Health requirements.

"Suburbia" can be enlarged for permanent use, or can be dismantled and re-erected elsewhere with virtually complete salvage of components. Because they can be erected in 90-120 days (instead of 10 months, as for concrete-type plants), "Suburbia" installations can be ready to go on-stream almost as soon as sewage lines are completed.

Best of all, "Suburbia" involves less initial and operating capital than any other type of conventional sewage treatment plant. It is furnished and installed, on a turnkey basis, only, by . . .

MUNICIPAL SERVICE COMPANY

Your sewage service—our full responsibility

4625 Roanoke Parkway • Kansas City 12, Missouri

Telephone: JEfferson 1-9500

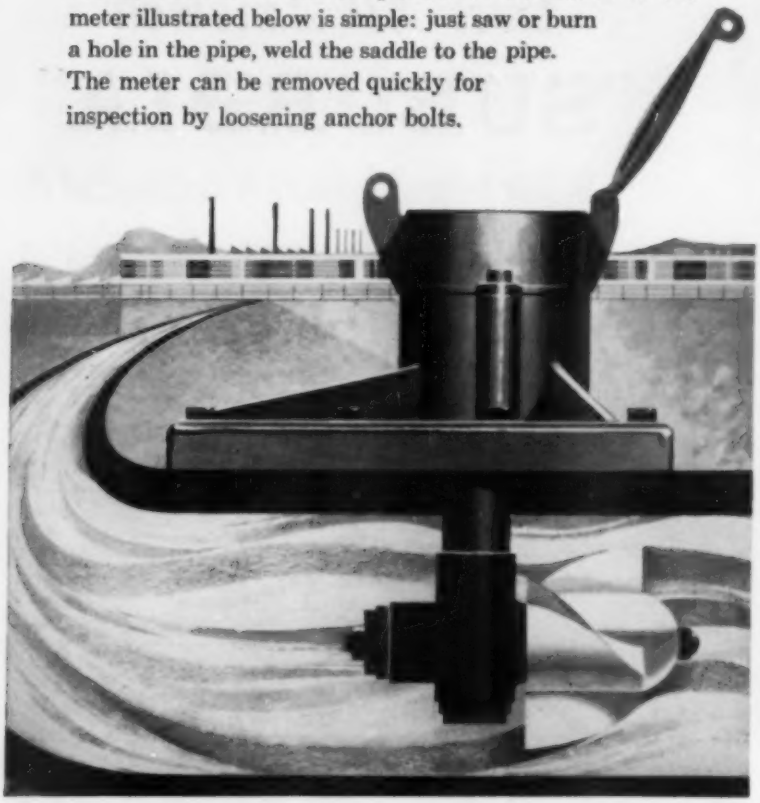
To order these helpful booklets check the reply card opposite page 34.

Increase efficiency and water profits with

MEASURE-RITE propeller meters

Measure-Rite meters can be installed on new or existing lines . . . for accurate, dependable water metering control.

They will register accurately whether mounted in horizontal, vertical or *inclined* positions. Installation of the meter illustrated below is simple: just saw or burn a hole in the pipe, weld the saddle to the pipe. The meter can be removed quickly for inspection by loosening anchor bolts.



Free flow design
assures low loss of head

In the Measure-Rite assembly, the propeller is positioned *forward*, fully centered in the metering chamber for greater metering accuracy. Free flow design provides least restriction of flow — minimizing loss of head.

Send for Bulletin MR-105 describing the complete line of Measure-Rite propeller meters. Address inquiries to:

MEASURE RITE, INCORPORATED

A Subsidiary of BADGER METER MFG. CO.
4545 W. BROWN DEER RD. • MILWAUKEE 18, WISC.

Sewage Treatment Engineering Data Manual

511. This manual contains a brief outline of the various accepted methods of treating sewage and some of the problems, advantages and disadvantages of each. Check the reply card or write Smith & Loveless, Inc., Division—Union Tank Car Co., Lenexa, Kansas for design notes, charts and drawings.

Clean Sewers Cost Less Than New Ones

554. Here is news on 1960-models sewer-cleaning equipment that can keep money in your municipal pocket. To get latest literature on the O'Brien line just write O'Brien Manufacturing Corp., 5632 Northwest Highway, Chicago 46, or check the card.

Weinman Horizontal Non-Clog Centrifugal Pumps

579. Non-clog pumps for sewage and sludge in municipal plants are covered in literature from the Weinman Pump Mfg. Co., 290 Spruce St., Columbus 8, O. Specifications and dimensions are included.

Equipment For Sewage Disposal Plants

583. Sewage gas meters, gas regulators, lubricated plug valves and water meters are described in Bulletin C-5200-3, available from Rockwell Mfg. Co., Meter and Valve Div., 400 N. Lexington Ave., Pittsburgh 8, Pa. Check the reply card.

Helpful Data on Distributors for Bituminous Materials

611. Pressure distributors featuring uniform pressure and temperature, accurate displacement pumping, convenient operation are described in literature of Standard Steel Works, North Kansas City, Mo.

Catalog on Steel Grating

645. New ideas in flooring, walkways, stair treads, platforms and shelving are covered in Catalog 2527R available from Blaw-Knox Co., Dept. W., Pittsburgh 38, Pa. Check the reply card for information on choice of cross bar and bearing bar designs and spacings.

Reinforced Concrete Pipe For Culverts and Sewers

672. Elliptical Lo-Hed and Hi-Hed pipes, round pipe and flat base pipe are described fully in literature from American-Marietta Co., Concrete Products Div., 101 East Ontario St., Chicago 11, Ill. Headwall details, discharge curves, hydraulic capacity tables and hydraulic properties are included. Check the reply card.

Full Line of Sewer Cleaning Equipment

681. Everything for rodding sewers from hand operated equipment to the fully mechanized SeweRodeR. Tools for all types of stoppages are operated by Flexicrome Steel Sewer Rods. Featuring the Truck-Loder which dumps sewer deposits directly into truck, a complete range of Bucket Machines is offered. All equipment is described in 48-page Catalog 55-A. Flexible, Inc., 3786 Durango Ave., Los Angeles 34, Calif.

WATER WORKS

In-Place Cement Lining of Small and Large Pipe

23. A catalog describing a process of in-place centrifugal cement lining of water, sanitary and storm drain pipelines from 4 to 144 ins. in diameter is available from the Centriline Corp., Raymond International Inc., 140 Cedar St., New York 6, N. Y. Check the reply card for sample specifications and test results.

Handbook on Spiraflo Clarifier Design

28. Comprehensive 36-page Bulletin 126 gives details of clarifier design, operating results, applications and full specifications for the Spiraflo clarifier for water and waste treatment. To get your copy check the reply card or write to Lakeside Engineering Corp., 222 West Adams St., Chicago 6, Ill.

BADGER'S COMPOUND WATER METER ASSURES FULL REVENUE FOR ALL WATER DELIVERED

Wherever water flow rates fluctuate considerably during the day — in schools, factories, hotels, theaters, apartment houses, dairies, laundries — Badger's compound meter assures economical, efficient service.

This compound meter combines Badger's disc and turbine meters to provide accurate registration at all rates of flow. You get the full revenue to which your water department is entitled for water actually delivered.

It is the industry's only compound meter where only one side operates at a time. A patented balanced compounding valve directs small streams through the disc meter, large streams through the turbine side... for accurate measurement of all rates of flow, less wear and longer service life.

Write for complete details now.

Badger Water Meters

BADGER METER MFG. CO. • 4545 W. Brown Deer Rd. • Milwaukee 1B, Wisconsin • *Offices in principal cities*

To order these helpful booklets check the reply card opposite page 34.

"Call FOSTER... get Line Pipe PLUS"

When you need large diameter pipe, especially 12¾" thru 48", L. B. Foster Co. can supply all you need from any one of its seven nationwide warehouses. And where's the "plus"? It's the "Faster From Foster" service that speeds your order.

As one of the country's major pipe specialists, Foster offers a one stop source to water works engineers and superintendents for municipal and industrial line pipe. This includes bare pipe and "controlled-quality" coating and wrapping—or lining—up to 78" diameters, and to all standard specifications.

Also, check Foster for savings on Structural Grade pipe—ideal for non-pressure use, and for water well casing and pump columns.

Write **L. B. FOSTER CO.** for Stock List PW-7. Pittsburgh 30, New York 7, Chicago 4, Houston 2, Los Angeles 5, Atlanta 8, Cleveland 35.

Faster From Foster

Pipe · Valves · Fittings · Piling · Rail

Propeller Meters For Dependable Water Metering Control

53. The complete line of Measure-Rite propeller meters are described in Bulletin MR-105 available from Measure-Rite, Inc., 4343 W. Brown Deer Rd., Milwaukee 23, Wis. Check the card for details on these accurate meters.

How to Select Right Angle Drives

62. Data-filled Catalog 31 of Johnson Gear & Mfg. Co., Ltd., 8th & Parker Sts., Berkeley 10, Calif., makes it easy to select the correct right-angle gear drive for deep well turbine and other vertical shaft pumps. Includes details on the Johnson "Redi-Torq" gear drive. To get your copy just check the reply card.

For Fast, Smooth Pipe Cuts

68. Descriptive literature on the Reed 4-wheel hinged pipe cutter which operates in close quarters, gives quick, easy right-angle cuts, and is available from Reed Mfg. Co., Erie, Pa. Check the reply card.

Efficient Coagulation With Ferri-Floc

69. Advantages claimed for Ferri-Floc as a coagulant include wide pH range, quick floc formation, manganese removal control of certain tastes and odors plus other aids in high quality water production. Check reply card for complete Ferri-Floc data. Tennessee Corp., Grant Bldg., Atlanta, Ga.

100 Page Book Helps Solve Water Problems

71. pH and Chlorine Control. A discussion of pH, Chlorine and Phosphate Control and descriptions of comparators for making colorimetric analyses. A 100 page booklet is available by checking reply card. W. A. Taylor & Co., 7304 York Road, Baltimore 4, Md.

Manual on Instrument Accessories and Supplies

96. The 60-page loose-leaf book, Catalog 500, includes specifications, part numbers and prices for more than 250 commonly furnished instrument parts and supplies. It is divided into 5 sections: Mechanical; pneumatic; electric-electronic, general, and tools and service. Check the reply card or write The Foxboro Co., Foxboro, Mass., for your copy.

The Submersible Pump You have Been Waiting For

141. Electric, fully submersible, portable, runs dry without damage, no priming, and other outstanding advantages. All are described in Flygt Bulletin B-80L of Flygt Corp., Hoosick Falls, N. Y. Address them or just circle the number on our card.

AWWA Fire Hydrants and Gate Valves

155. Above-ground maintenance Mueller AWWA improved fire hydrants and minimum maintenance Mueller AWWA non-rising stem gate valves are described in literature from Mueller Co., Decatur, Ill.

Nobody Loves Algae

164. And when you use Hyamine 2389 in your swimming pools there just aren't any algae to love. How and why this algicide works is fully described in a 12-page booklet, to be had from Rohm & Haas Co., Agricultural and Sanitary Chemicals Dept., Washington Square, Philadelphia 5, Pa. Just check the reply card.

A Quick Comparison of Water Meters Helps

274. That is the purpose of the new bulletin describing the newest accomplishments in water meter design and manufacture. With it comes a Condensed Catalog of the Rockwell line. Ask for Bulletin No. W-811 from Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa., or check the card.

Waterworks and Municipal Castings

293. Meter boxes and covers, yokes and couplings, service boxes and manhole covers are covered in 24-page catalog. Check the reply card or write H. W. Clark Co., Mattoon, Ill., for full specifications.

(More listings on page 52)

MODEL HF

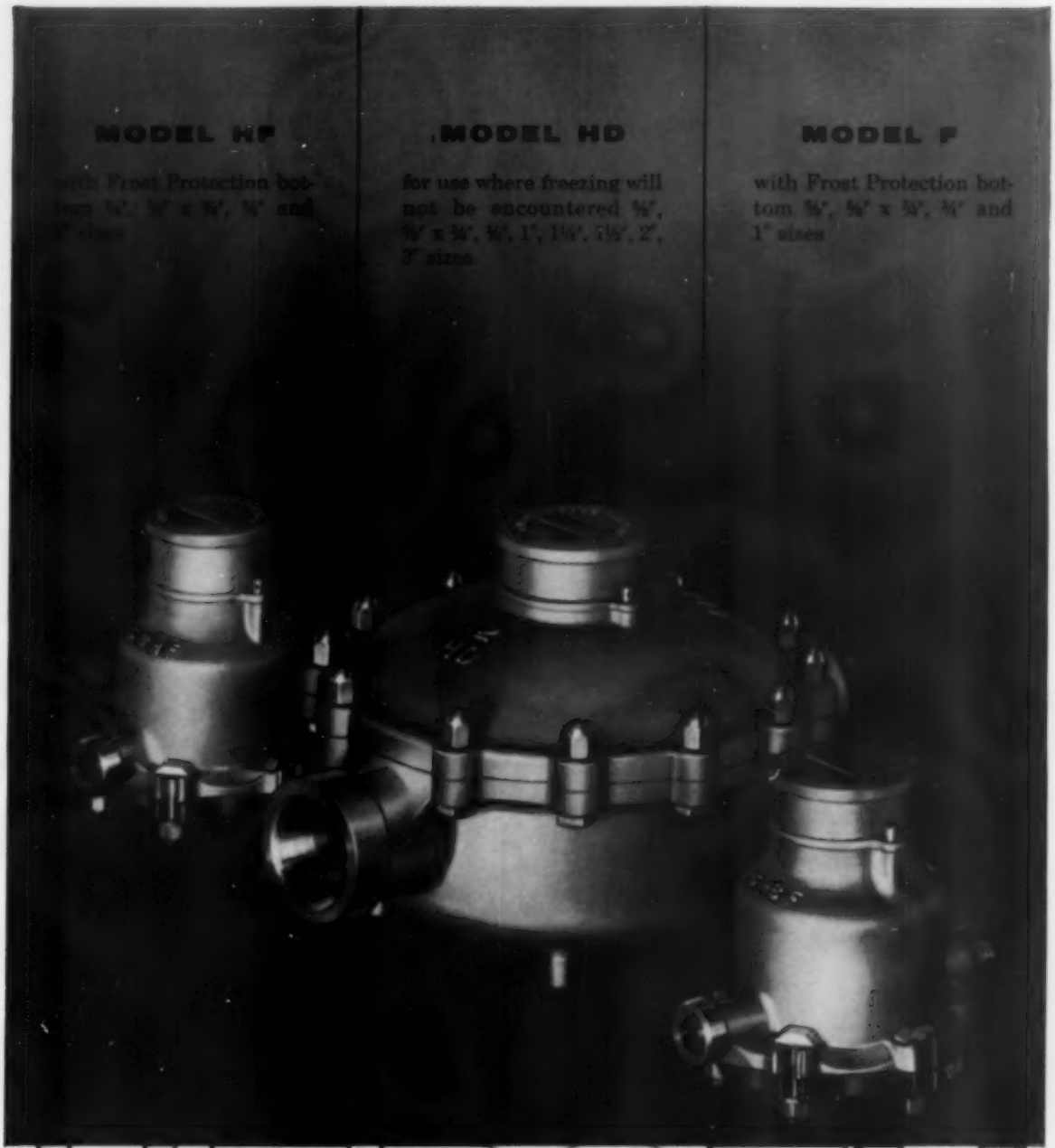
with Frost Protection bottom ¾", ¾" x ¾", ¾" and 1" sizes

MODEL HD

for use where freezing will not be encountered ¾", ¾" x ¾", ¾", 1", 1¼", 1½", 2", 3" sizes

MODEL F

with Frost Protection bottom ¾", ¾" x ¾", ¾" and 1" sizes



HERSEY

DISC METERS

CASH REGISTERS FOR THE WATER WORKS INDUSTRY THAT RING UP EVERY DROP.

Hersey-Sparling
Meter Company
HERSEY PRODUCTS
DEDHAM, MASSACHUSETTS

ALLIS-CHALMERS D

58 NET ENGINE HP

HANDLES UTILITY LOADING

1 **Does the thousand and one jobs that usually require special machines. Rugged ¾-yd bucket operates hydraulically. Lets you load out excess material while finishing work is going on.**

MAINTAINS SHOULDERS IN ONE SAFE PASS

2 **Lets one man rebuild and maintain miles of shoulder every day. Grader blade levels shoulder, fills voids — maintainer blade spreads excess material — trailing striker blade clears highway edge — all in ONE PASS, with the machine safely off the road. The ¾-yd bucket is interchangeable with the maintainer.**

ONLY 4-IN-1 GRADER

The Allis-Chalmers Model D grader and its attachments give you timesaving, money-saving flexibility . . . not only for grading, but for loading, scarifying, and maintaining road shoulders, too.

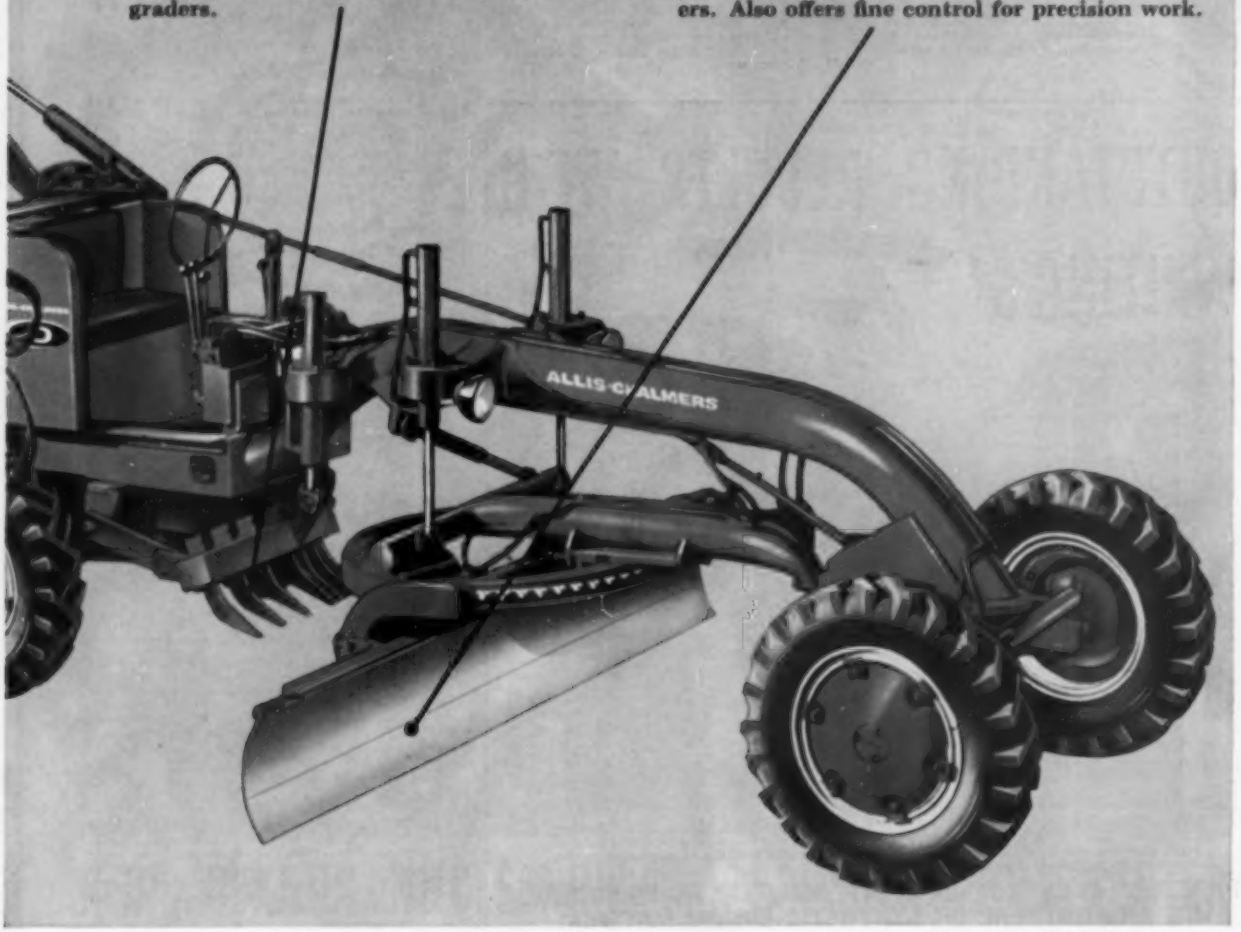
move ahead with

SCARIFIES TOUGH, HEAVYWEIGHT MATERIALS

3 Seven-tooth design cuts 27¾-in. swath, with 4,900-lb penetrating force. Mid-ship-mounted to allow good steering while working. Will scarify material on which you might expect to use the big graders.

BIG GRADING CAPACITY WITH Roll-Away MOLDBOARD

4 Designed to lift and roll loads. Handles more dirt than ordinary blades, yet requires no additional power. With this exclusive moldboard, the Model D will roll loads as big as those you're now pushing with much bigger graders. Also offers fine control for precision work.



ROLL-AWAY is an Allis-Chalmers trademark.

YOU CAN BUY

Up front, the D is a grader — capable of tackling all your road and street work. Attachments add many practical uses — let you put a D on other jobs when grading is finished. Flexibility like this is bound to make a tax dollar go further.

A Model D costs less right from the start. It's scaled to your budget — so low, in fact, that you can own two or three for what a big machine would cost.

You're invited to personally check the D's ability to handle your community's jobs. Your dealer will arrange a demonstration.

Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS AC

power for a growing world

To order these helpful booklets check the reply card opposite page 34.

Here's a New Note in Filter Cleaning Equipment

202. Just announced, a new S-Type Filter Arm that is reported to increase filter cleaning efficiency by 25 to 30%. Doubles the agitating impulses and improves your plant performance strikingly. Adaptable to present installations, too. Write Palmer Filter Equipment Co., Erie, Penn., or circle reply card.

Complete Catalog and Reference Data on Valves and Fittings

211. The entire M & H line of valves, fittings and accessories for water works, filtration, sewage disposal and fire protection are illustrated and fully detailed in Catalog 52 issued by M & H Valve & Fittings Co., Anniston, Ala. In addition to complete data on these products, there are many pages devoted to helpful engineering data. Every designer should have a copy.

Renew Pipe Performance With Cement Mortar Lining

222. Application of the Tate and Spunline process for cement mortar lining of existing pipe lines with a minimum of interruption of service is described, with diagrams, photographs and specifications in Catalog 15-58. Write to Pipe Linings, Div. of American Pipe and Construction Co., P. O. Box 457, Wilmington, Calif., or check the reply card.

Helpful Data on Water Meters

230. It is to the interest of every water works superintendent and engineer to have full data on dependable Badger water meters and related meter products. Complete data on all types of disc, turbine and compound meters, meter test equipment, yokes, strainers and alarm registers are supplied in an attractive binder by Badger Meter Mfg. Co., Milwaukee 23, Wisconsin.

Lay Water Mains Faster With "Fluid-Tite" Couplings

184. Get permanent water-tight joints automatically with K & M "Fluid-Tite" couplings for K & M asbestos-cement pressure pipe. Full details on this faster installation and self-energizing couplings are available from Keasbey & Mattison Co., Ambler, Penna.

Design of Prestressed Concrete Tanks

194. An 8-page technical Bulletin, T-19, on the Design of Prestressed Concrete Tanks, gives engineering data and formulas of general interest to anyone considering prestressed concrete for storage tanks. Check the reply card or Write to The Preload Co., Inc., 355 Lexington Ave., New York 1, N. Y.

Manual on Pipe Finding Techniques

213. A manual on special pipe finding and leak detecting techniques of interest to utilities, municipalities, oil and gas companies is announced by Fisher Research Laboratory, Inc., 1961 University Ave., Palo Alto, Calif. The manual contains a number of articles on locating buried pipes and cables and detecting and locating fluid leaks in pipe lines.

Heavy Duty Air Cooled Engines For Many Uses

223. Power and weight specifications,, dimensions and uses are fully covered in literature issued by Wisconsin Motors Corp., Milwaukee 46, Wis., on their air-cooled engines. Also available is a service map and a list of their distributors and approved service stations.

Meters and Instruments For Water Works

224. An attractively arranged 40 page catalog in full color issued by Hersey-Sparling Meter Co., 225 No. Temple City Blvd., El Monte, Calif., furnishes concise data on the full line of Sparling meters, indicator-totalizer-recorder instruments and other special instruments and controls. Check the reply card for your copy, or write for Bulletin 314.

OUTSTANDING RESULTS WITH WHITING'S *Prostran*

POLYPROPYLENE

John Kiley, President of Atlantic Broom Company, Readville, Mass., with two new Prostran brooms, fresh off the production line. Note the full body and uniformity of the brooms, with bristles set close together, and so stiff that they easily support the weight of the heavy broom core without sagging.

PROSTRAN-POLYPROPYLENE OFFERS ADVANTAGES SUPERIOR TO ANY NATURAL OR SYNTHETIC BROOM MATERIAL!

- Reduced Cost Per Sweeping Mile
- Longer Lasting Use-Life
- Excellent Sweeping Efficiency
- Minimum "Down-Time" For Repeated Broom Filling
- Toughness and Superior Abrasive Action
- Excellent Flex-Life for Ideal Bend Recovery
- Excellent Resistance To Chemicals, Solvents, Greases, Oils and Many Common Acids
- Heavy Duty Efficiency And Clean Sweeping
- Top Performance Under All Weather Conditions

Distributed In New England States by Atlantic Broom Co., Readville, Mass.
Or Contact Us For Nearest Distribution Point To You

PHONE
Burlington, Vt. UNiversity 4-7414

* Prostran is made with Pro-Fax† — polypropylene.

†Reg. P.M. Hercules Powder Co.

E.B. & A.C. WHITING CO. QUALITY SINCE 1873

E.B. & A.C. WHITING COMPANY
Burlington, Vermont

Use The Reply Card

Welded Steel Pipe, Steel Piling and Corrugated Metal Culvert Pipe

273. Catalog on continuous electric welded steel pipe, cement mortar lined and coated pipe, coal tar lined and wrapped pipe, water well casings and corrugated culvert pipe is available from Southern Pipe & Casing Co., A Division of U. S. Industries, Inc., P. O. Box C, Azusa, Calif. Check the reply card.

The Asset of Accuracy in Water Meters

350. . . . is outlined in a folder on conical disc piston meters that provide enhanced sensitivity at low rates of flow with accuracy throughout the full capacity range. For folder on Model HF meters address Hersey-Sparling Meter Co., P. O. Box 31, Dedham, Mass., or check our card-number.

Standardization of a Complete Line of Water Service Equipment

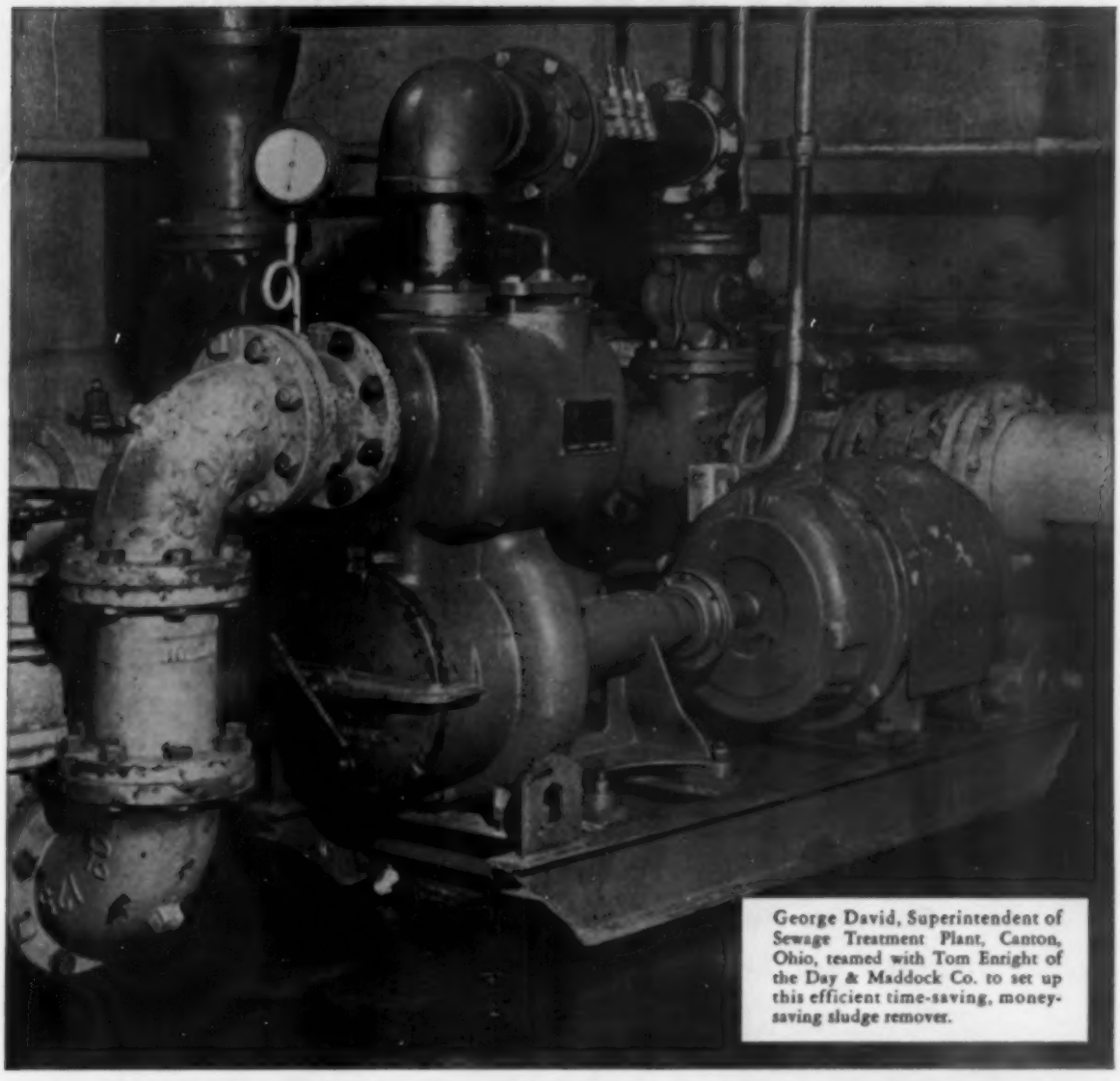
389. Standardization can be a handy thing where the line includes stops, boxes, clamps, strainers, and meter setting equipment. You can find it all at Mueller Co. Address them at Decatur, Ill. for folder W-8880 or just circle the number above on our card.

Many Fuels Will Power Enterprise Engines

393. New bulletin tells of economies and advantages of the Enterprise Engine "Dual Fuel" system. Ideal for stationary power plants, sewage treatment plants, and pumping stations. Address Enterprise Engine & Machinery Co., 18th and Florida Sts., San Francisco 10, Calif.

How to Select and Specify Water Stops

406. Comprehensive application and installation data on all types and sizes of water stops are covered in valuable Bulletin MRG-473. Address The Gates Rubber Co., 999 South Broadway, Denver 17, Colo., or check number on the card.



George David, Superintendent of Sewage Treatment Plant, Canton, Ohio, teamed with Tom Enright of the Day & Maddock Co. to set up this efficient time-saving, money-saving sludge remover.

RECIRCULATION AND CLEANING PUMP SOLVES CANTON DIGESTER PROBLEM Gorman-Rupp Sewage Pump cleans with no downtime and major savings

Problem—To remove 7-years' accumulation of sludge from 10 huge digesters. With mechanical shoveling devices, it cost $5000 to clean only one digester. And during cleaning, digester was totally inoperative for 6 weeks.

Answer—A Gorman-Rupp Model 16A2-B Pump. Its unique action first agitates sludge into a common mixture by circulating digester liquid under pressure. Then, with valves reversed, pump draws off liquid and suspended solids for disposal.

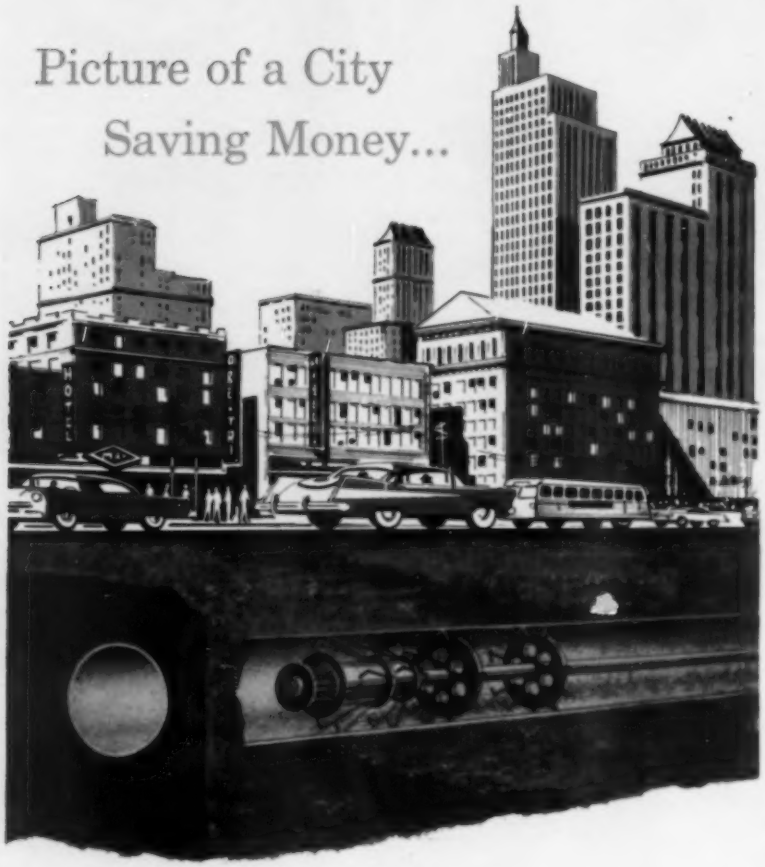
Result—Each digester could be cleaned in only 21 days. Only outlay is cost of 6″ pump, electric motor, and labor of opening and closing 2 valves twice a day.

4″ and 6″ pumps can be connected to your power or ordered complete with power units. Write for complete specifications.

Fast-Action End Plate. Releases for access to impeller and renewable wear plate. Impeller is 2-vane trash type that handles spherical solids up to 2½″ in diameter.

THE GORMAN-RUPP COMPANY
305 Bowman Street • Mansfield, Ohio
GORMAN-RUPP OF CANADA, LTD
St. Thomas, Ontario

To order these helpful booklets check the reply card opposite page 34.



Spunline Relines Pipe Lines in-place without removing the pipe

Another city such as Spokane, Dallas, or Los Angeles will soon be enjoying the savings of another rehabilitated pipe line. The flow will increase, the pumping cost will drop and the pipe line will be good as new for at least another quarter of a century.

And traffic will move without interruption or inconvenience to the public.

Spunline® is applicable to pipe lines down to 4" and may be used in cast iron, steel, concrete and wrought iron pipe lines.

Write, wire or phone PIPE LININGS Inc.

Subsidiary of American Pipe and Construction Co.

2414 East 223rd Street, Wilmington, California
P.O. Box 457 • Phones: SPruce 5-3273 — TErminal 5-8201
Rail Address, Pacific Electric, Watson, California

Measurement of Liquid Flow Across Weirs

418. The Burgess-Manning Type ML meter is applied to weir boxes for measurement of flow across any V-notch weir or parshall flume. For specifications and installation procedures write Burgess-Manning Co., Penn Instruments Div., 4110 Haverford Ave., Philadelphia 4, Pa.

A Flat Statement About Round Tanks

434. The title of a new finely illustrated booklet is "Steel Tanks Store Water Best." It gives pictures, essential data, and a fine impression of strength, water-tightness and beauty combined in sturdy structures. For your copy write Steel Plate Fabricators Association, 105 W. Madison St., Chicago 2, Ill., or check our card.

American Ductile Iron for Pipe, Tubing, Casing and Fittings

463. A 36-page illustrated catalog that describes the complete line of American Ductile iron products is available from American Cast Iron Pipe Co., P. O. Box 2603, Birmingham 2, Ala. Check the reply card for technical data including grades, specifications, dimensions and

Locate Water Leaks Quicker and Easier

476. An aquaphone that requires no mechanical connection between probe and diaphragm to break or cause of trouble is described fully in literature from Aqua Survey & Instrument Co., 824-B North Bend Rd., Cincinnati 24, Ohio.

Halve Your Time on Pipe Pushing and Pulling

517. Continuous-motion machine works all the time to keep pipe moving fast until it is through. Hand or air powered. Write for new folder to The Trojan Mfg. Co., 1112 Race Drive, Troy, Ohio, or use our reply card.

Play Safe with Automatic Controls

603. Remote engine and pumping controls of every sort are fully described in a series of bulletins offered by Synchro-Start Products Inc., 8151 N. Ridgeway Ave., Skokie, Ill. Write them or circle the above number on our card.

Keeping Up-to-Date on Fire Hydrants . . .

608. will be made more certain by having this latest folder on Iowa hydrants in your files. Dependable design; ground line break flange construction. Ask for Bulletin X9 of Iowa Valve Co., Oskaloosa, Iowa, or circle the reply card.

When the Frost is on the Meter

615. If it is an American frost-bottom meter freezing is no major problem. The replaceable center section breaks out leaving the mechanism undamaged. Bulletin 58 tells the story. Address Buffalo Meter Co., Inc., 2917 Main St., Buffalo 14, N. Y., or circle reply card.

Turn Your Water Meter Reading Inside-Out

671. The Visi-Meter is a remote recording and indicator system that eliminates the need of entering the home to read water meters. It records within an accuracy of 0.1 percent. Check the reply card or write Visi-Meter, Inc., 301 North 17th St., Kansas City, Kans., for literature.

Just Turn on the Rain

674. Rain Bird underground sprinkling system beats depending on the weather to keep your roadsides, parks and shrubbery green. Full and interesting details about the system, local dealers, etc. can be had from Rainy Sprinkler Sales Div., Peoria, Ill. Better still, check our card.

Electronic Locators for Water Mains, Services, Valves and Boxes

677. Miniaturized line locator that is encased in a molded glass fibre container and has transistors that have a rated life of 70,000 hours and weighs only four lbs. when completely assembled is described in literature from Wilkinson Products Co., 3067 Chevy Chase Drive, Pasadena 3, Calif. Check the reply card.

Proved performer on county work **BANTAM T-350**

"For county work BANTAM has no equal"

"It's where we need it when we need it"

"There's just no comparison between BANTAM and other machines"

Carrier-mounted BANTAM T-350 loads out 600 yards of material in an 8½-hour day, excavating pit-run sand and gravel.

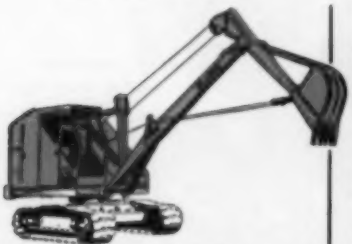
Down Mississippi way, you'll hear these comments from the men in the Pearl River County Beat (District) 4 Highway Department where their second BANTAM is speeding up road-building and other work. Pearl River chose BANTAM again because BANTAM's high speed, dependability and lowest-of-all operating cost make it the ideal machine for all types of excavating, lifting and handling jobs. County Supervisor W. E. Moody says, "For county work, BANTAM has no equal."

For excavating, loading, ditching, pile driving, culvert installations, materials handling, bridge construction or repairs, BANTAM's big-rig features and exclusive engineering advantages assure Pearl River the highest return on its BANTAM investment. BANTAM's job versatility has proved itself time and again over the 260 miles of road in the district.

Size-up BANTAM for your work!

Let us prove to you why BANTAM is the most useful, all-round rig for cities, towns and counties—the wisest investment on *every* count!

BANTAM, with clamshell bucket, prepares drainage ditch for new road. BANTAM's operational ease and big-rig speed help it to outproduce any other in its class.



BANTAM C-350—New crawler rig features an all-new undercarriage with extra stability; standard 2-speed, independent travel, and a wide choice of options. 7- and 8-ton capacity.

BANTAM CR-350—All-new self-propelled travels and works with one engine and one operator . . . offers automotive power steering, independent travel, and new, higher travel speeds. Capacity to 11 tons. 4 x 2 drive standard . . . 4 x 4 optional.

With its 11 quick-change attachments, BANTAM is ready to work anywhere. What's more, 25 optional features enable you to buy your BANTAM exactly as you want it—to fit your specific job needs.

PW-261

SCHIELD Bantam Co.

301 Park Street, Waverly, Iowa

WORLD'S LARGEST PRODUCER OF TRUCK CRANE-EXCAVATORS

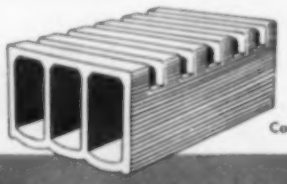
LEADERS IN THE FIGHT FOR CLEAN WATERS

Trickling Filters with TFFI Specification clay underdrains

Trickling Filters with TFFI Specification vitrified clay underdrain blocks make the winning combination for water pollution control. More of them have been built in the past 15 years than any other type. Together they offer economy, efficiency and ease of expanding the plant. In trickling filters your best assurance of long, trouble-free operation lies in the TFFI vitrified clay underdrains. They resist ravages of acids, alkalis and bacteriological action. TFFI manufacturers alone offer a 50-Year Guarantee as their blocks are made in modern plants under rigid controls of quality that no substitute material can approach.

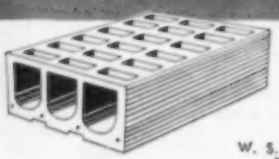
New Handbook Now Being Distributed

Mr. City Engineer and Mr. Consultant! If you haven't received your free copy of the new data-filled TFFI Handbook of Trickling Filters, which contains latest ASTM Specifications for vitrified clay underdrain blocks, write for a copy. Send your request to the nearest member firm.

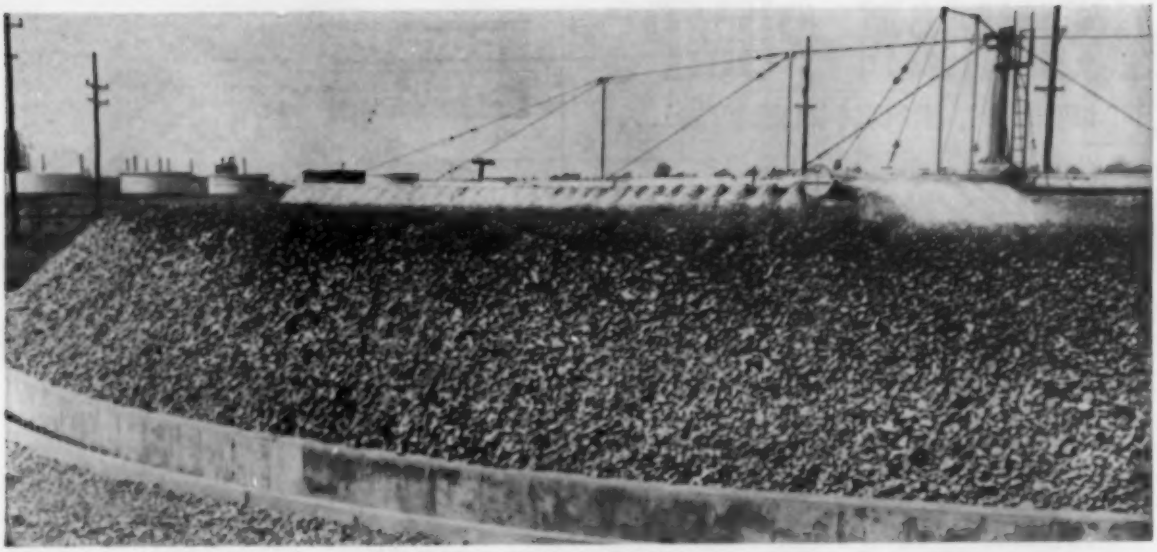


TRANSLOT
Connelton Sewer Pipe Co.
Connelton, Ind.

TFFI Trickling



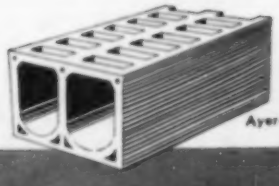
DICKEY
W. S. Dickey Clay Mfg. Co.
Kansas City 6, Mo.



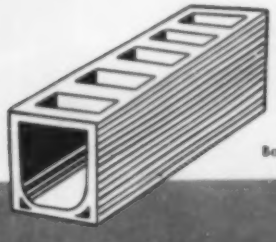
Shell Oil Co. trickling filter, Wood River, Ill. Photo courtesy National Slag Association.

Good fishing follows good filters.

TFFI blocks in trickling filter floor, Raleigh, N. C.

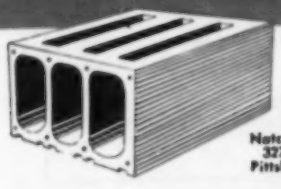


ARMCRE
Ayer-McCarel Clay Co., Inc.
Brazil, Ind.

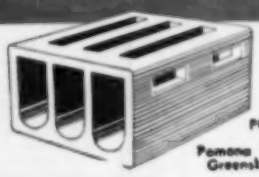


BOSCO
Bowerston Shale Co.
Bowerston, Ohio

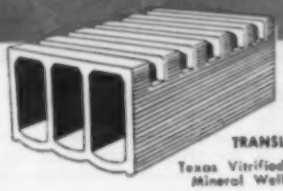
Filter Floor Institute



NATCO
Natco Corporation
327 Fifth Ave.
Pittsburgh 22, Pa.



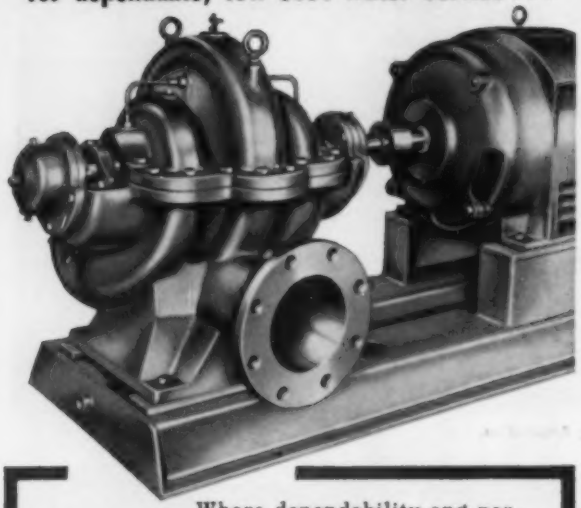
POMONA
Pomona Terra-Cotta Co.
Greensboro, No. Car.



TRANSLOT
Texas Vitrified Pipe Co.
Mineral Wells, Texas

WEINMAN PUMPS

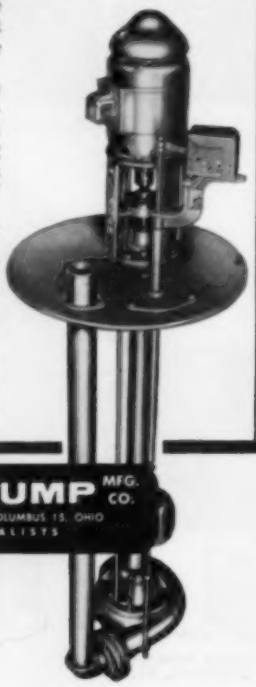
for dependable, low-cost water service...



Where dependability and performance count most—at critical pumping stages of water movement—you'll find Weinman Pumps. There's good reason for it, too. Weinman Split-Case Centrifugal Pumps are precision built to function continuously at top efficiency, with little or no maintenance. The horizontally split casing speeds routine maintenance and increases the "in-service" time of Weinman Pumps. Rotating parts are quickly inspected and easily removed or replaced without disturbing connections or driver. And, the rugged construction of Weinman Pumps stands up under the grueling punishment of 'round-the-clock operation. Municipal engineers and taxpayers alike benefit from the real economy of Weinman's dependable year-in, year-out trouble-free on-line service.

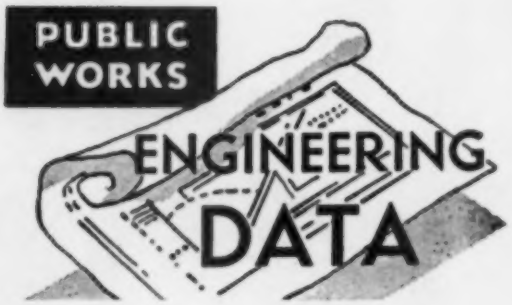
And, you get the same uninterrupted, dependable service from Weinman's outstanding line of Sewage Ejectors for the swift handling of liquids of varying viscosities carrying all types of foreign matter in suspension.

Write today for full information on all Weinman Centrifugal Pumps and for the competent, on-the-job assistance of your local Weinman Specialist, check the Yellow Pages.



THE WEINMAN PUMP MFG. CO.
290 SPRUCE STREET COLUMBUS 15, OHIO
CENTRIFUGAL SPECIALISTS

MEMBER



Disaster Organizational Plan

The Disaster Organizational Plan of Fort Lauderdale, Fla., prepared by C. S. McKinney, Director of Utilities, and published as a special booklet, provides detailed procedures for the operation of each water plant and sewage plant in the city. While the plan is designed primarily to meet the contingency of a hurricane, it is believed to be flexible enough to cover other disasters and to coordinate with local and national Civil Defense programs.

The plan divides the city into four areas, each of which is further divided into three sections. A supervisor is provided for each area, with headquarters at sewage and water plants and emergency repair crews will be on duty in each section These emergency repair crews will have radio-equipped repair trucks located at each section station and will be supplied with all necessary tools. Detailed procedures for operation, under emergency conditions, have been prepared for each water and sewage plant, including the use of portable emergency power generators, pumps, etc.

Details of the plan are too voluminous to present here and any condensation would not do justice to the careful planning and attention to details that are a basis for the organization. Main headings are: Planning and supervision; water treatment plants; water and sewer distribution; sewage treatment plants; maps; and emergency telephone listings. Under most of the headings, the outline covers: Headquarters section; communications; general information and procedures; hurricane procedures; and detailed procedures.

Of special interest is the listing of standby power units available. At the Dixie water treatment plant there are two diesel engines to drive high service pumps; one diesel driven 25 KW generator; one 30 KW gasoline driven generator; and one diesel engine to drive a 75 KW generator. At the Fiveash water treatment plant are two diesel engines to drive high-service pumps; one 5 KW gasoline engine driven generator; and four 40 KW diesel generators. These are moblie units and can be used where necessary. The auxiliary equipment at the Dixie plant provides power to operate at the rate of 7.5 mgd; at the Fiveash plant, operation is possible at 4 mgd.

The water and sewer distribution system has one

The column usually found on this page, "Commentary on Water and Sewage Treatment," will not appear again. We regret exceedingly to announce that the author, R. S. Rankin, died on June 6.

These magnetic meters cost no more than conventional meters but outperform them all

The greatest bargain among all meters is the Rockwell Sealed Register type. Size for size they cost no more than ordinary meters; cost less in fact than meters fitted with special registers to prevent fogging.

But while initial costs are comparable, what a plus value you get with these *magnetic* meters. You get a hermetically sealed register that prevents condensation and corrosion—makes these meters always easy to read. This sealed register case also contains and protects all the gearing for intermediate reduction as well as register operation.

In this meter alone you get a powerful magnetic drive that *positively* transmits motion from the measuring chamber to the register without the need for a stuffing box. Finally you get fewer parts to wear and only two of these run in water.

What does all this add up to? It totals *more* in meter accuracy and durability, *less* in repair parts costs and meter shop operations. For a fact-packed bulletin write Rockwell Manufacturing Co., Dept.PW7,Pittsburgh 8, Pa. In Canada, Rockwell Manufacturing Company of Canada, Ltd., Box 420, Guelph, Ont.

POWERFUL MAGNETIC DRIVE
Illustrating how the driver magnet (held in hand) revolves around a watertight compartment at base of register to push the follower magnet, which in turn drives the register shaft.

SEALED REGISTER METERS

another fine product by

ROCKWELL

ESSICK

VIBRATING COMPACTORS

ESSICK VR-28-W PATCHING ASPHALT IN GARDEN GROVE, CALIF.

"MAINTENANCE PRODUCTION TRIPLED...

...COSTS DECREASED 80%"

SEWARD H. DART, STREET MAINTENANCE SUPERINTENDENT-SHOWN WATCHING HIS 28" ESSICK VIBRATING COMPACTOR IN ACTION—STATES:

"Irrigation water tracked into the intersections and gutter aprons in Garden Grove, constantly eroded the asphalt and made maintenance a full time problem. As a result, our gutter and intersection patching required frequent reworking, and our costs were high.

"After a demonstration of the 28" Essick Vibrating Compactor, we knew we had found the answer. It was self-propelled, hooked on the tail gate of a dump truck, and produced compaction equivalent to an 8 ton roller on asphalt. Its high frequency vibration compacts an asphalt patch that is completely dense—that can be opened immediately to traffic without any marking or damage to the asphalt.

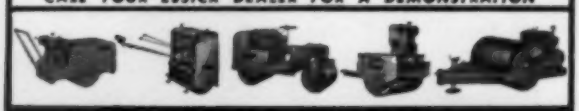
"Now with our patching unit consisting of the 1½ ton dump truck, an Essick 120 gallon Truck Mounted Emulsion Unit, a propane torch, and the Essick VR-28-W Vibrating Compactor, the patch life has been tremendously extended, our maintenance production has tripled, and our costs have decreased 80%.

"The Essick VR-28 really solved the patch problem for us."

SELF PROPELLED — MANEUVERABLE — PORTABLE

Essick High Frequency Vibrating Compactors are constantly exceeding the densities and specifications performed by other compaction methods, while creating new standards of compaction for all types of fills, sub base, base materials, and asphalt.

CALL YOUR ESSICK DEALER FOR A DEMONSTRATION



Also 14 models of Tandem Rollers from ½ to 14 Tons

ESSICK MANUFACTURING COMPANY

1950 Santa Fe Avenue, Los Angeles 21, California

850 Woodruff Lane, Elizabeth, New Jersey

Affiliated with THE T. L. SMITH COMPANY, Milwaukee, Wisconsin

gasoline operated generator to operate the base radio station and the street department base station.

The sewage treatment plants division has the following auxiliary power available: At Plant A, one 5 KW generator to operate radio base station and lights; at Plant B, Coral Ridge Golf Course, one 150 KW generator to operate the entire plant and a base station; at Plant D is also a 150 KW generator to operate the entire plant and a base section. At Pump and Compressor Station L, there is a 225 KW generator to operate the entire station; at Burdines pumping station there is one 40 KW diesel generator; and at Hospital pumping station there is a gasoline engine with emergency drive to operate one 200 gpm pump.

Polysulfide-Base Adhesive Seen as Important Engineering Tool For Highway Maintenance

The use of polysulfide-base adhesives has opened new possibilities in the maintenance of concrete roads, according to Thiokol Chemical Corporation. Extensive testing for the past six years has shown that these adhesives enable damaged areas to be repaired permanently with much less effort and expense than replacement of entire sections. These tests, conducted by the State of California's Division of Highways, indicate that when the polysulfide-base adhesive is applied immediately before a new concrete overlay, a permanent repair results.

A five step procedure with the polysulfide-epoxy adhesives is used to make the repair at reasonable cost.

To begin, the spalled or damaged concrete must be removed until only sound concrete remains. Then the entire area must be cleaned of loose particles as well as traces of oil.

The third step includes mixing (the adhesive is supplied in two packages, which will begin to cure after they are mixed) and application of the adhesive to the area to be patched. Spray equipment speeds the application, but brooms can also be used.

Fourth step in the technique is pouring of the new concrete before the adhesive sets. And finally the concrete is finished as with conventional concrete work.

The polysulfide-epoxy will cure and adhere to both the old concrete and the new despite the presence of water. This bond will subsequently prevent moisture from seeping into the bond area and will withstand far higher impact and compression than the concrete itself. Such applications have been in service for over seven years in California. Many other states have used this same technique.

There are several other techniques for handling remedial problems on highways with the adhesives. When pot holes are to be repaired, it often proves economical to use a polysulfide-epoxy mortar to fill the hole so that the highway may be opened to traffic immediately. The mortar is made by taking the combined ingredients of the adhesive and mixing the liquid with aggregate in various ratios. The resultant mortar is then applied to a cleaned pot hole and trowelled. Because graded aggregate is used, the patch will support traffic immediately so there is no down-time on the road. Regular mixing equipment may be employed.

According to Thiokol, the adhesive can be used to seal concrete surfaces of the roadway to prevent further deterioration due to salt intrusion. In this technique the adhesive is applied as a varnish might

Smith & Loveless
VERTICAL CLOSE-COUPLED "Non-Clog" SEWAGE PUMPS

Built to the most exacting requirements by the world's largest manufacturer of factory-built sewage lift stations.

The One Pump Designed to Meet All the "Must" Requirements for Sewage Service

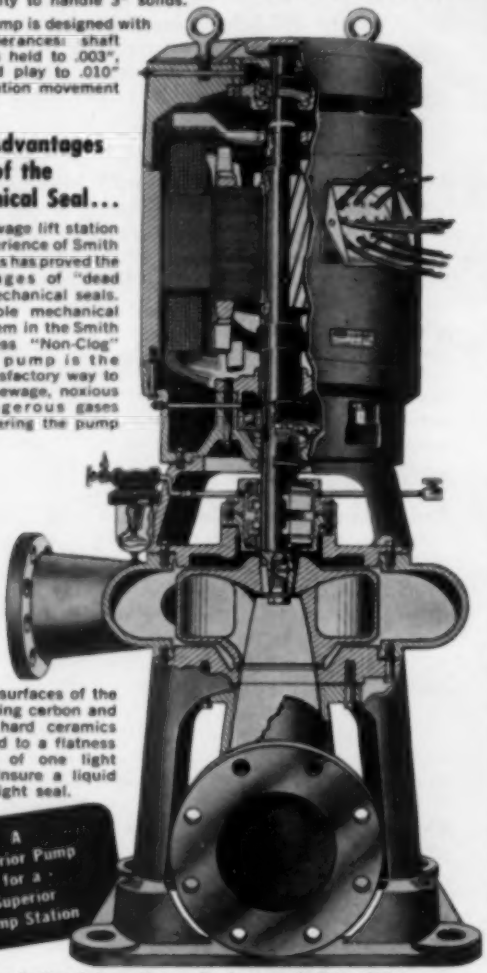
The Smith & Loveless "Non-Clog" sewage pump is the result of years of experience with over 1,400 varied pump station installations.

The ultimate in design and construction, the "Non-Clog" pump is precision manufactured of superior materials—with over-size shaft and bearings. Special attention is given to corrosion and abrasion resistance and ease of maintenance. Maximum pump efficiencies with ability to handle 3" solids.

The pump is designed with close tolerances: shaft runout is held to .003", shaft end play to .010" and vibration movement to .005".

The Advantages of the Mechanical Seal...

The sewage lift station field experience of Smith & Loveless has proved the advantages of "dead tight" mechanical seals. The double mechanical seal system in the Smith & Loveless "Non-Clog" sewage pump is the most satisfactory way to prevent sewage, noxious and dangerous gases from entering the pump room.



Mating surfaces of the long-wearing carbon and diamond-hard ceramics are lapped to a flatness tolerance of one light band to insure a liquid and gas-tight seal.

A Superior Pump for a Superior Pump Station

For further information, write for new Bulletin 500-A
Address: Department 40. (2447)

S&L Smith & Loveless
DIVISION — UNION TANK CAR COMPANY
PLANT LENEXA, KANSAS P. O. BOX 8884 • KANSAS CITY 15, MO

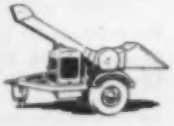
ASPLUNDH CHIPPERS CUT COSTS!

With an ASPLUNDH CHIPPER you can:

- **Save 75% of your loading and hauling costs—4 Truckloads of brush equal 1 of chips.**
- **Reduce disposal time, labor and equipment to an absolute minimum**
- **Speed clean-up—free men for more trimming time.**
- **Eliminate burning problems and dump costs.**
- **Provide income—a ready market exists for chips. Used for mulching, erosion control, walks, etc., and by nurseries, farms and zoos.**

No wonder Asplundh Chippers are the fastest-selling, most often specified chipper on the market today. The fact that you can chip *more brush faster at less cost* with an Asplundh Chipper has been *proven* by the largest tree company in the world. It is by far the best chipper you can buy.

Write *today* for full details. Better—ask for a prompt demonstration without obligation.



ASPLUNDH CHIPPER COMPANY
505 York Road, Jenkintown, Pa.
By Actual Test the Fastest Chipper Made

WATER TREATMENT PROBLEMS!

Ferri-Floc
TC
FERRIC SULFATE

ELIMINATES THE GUESS WORK

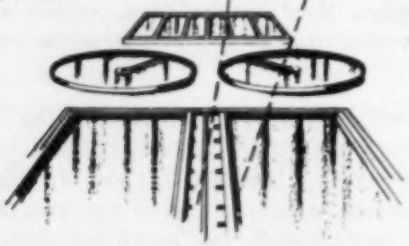
Ferri-Floc produces a smoother, trouble-free operation. Whatever your particular water treatment problem may be, you can depend on Ferri-Floc to do the job more efficiently and economically — Coagulates over a wider pH range — Increased filter runs — Rapid floc formation — Excellent taste and odor control and many other plus factors.

WATER TREATMENT

Efficient coagulation of surface or well water —Effective in lime-soda ash softening—adaptable in treatment of all industrial applications.

SEWAGE TREATMENT

Coagulates over wide pH range and provides efficient operation regardless of rapid variations of raw sewage—Very effective for conditioning sludge prior to vacuum filtration or drying on beds.



SODIUM SILICOFLUORIDE

For fluoridation of municipal water supplies —Available for prompt shipment.

For complete list of our products see our inserts in Chemical Week Buyers' Guide, Pages 173-176 or Chemical Materials Catalog, Pages 551-554.

For more detailed information make request on your firm's letterhead.

TC TENNESSEE CORPORATION
612-629 Grant Building, Atlanta 3, Georgia

be. Since the adhesive is clear, however, it will not be evident after curing.

In order to apply grit to a highway intersection or bridge roadway for skidproofing purposes, the grit is spread immediately after the coating is applied. The grit is then bonded tightly to the surface.

Thiokol makes only the polysulfide liquid polymer which is one of the principal ingredients of the adhesive. Actual formulation is done by companies throughout the country who sell the compounds directly and through building industry distributors.

So successful have the tests and applications been for these adhesives that Thiokol estimates it will develop into a large market. In addition to highways, these products will be used for runways, bridges, dams and buildings.

Solving a Storm Drainage Problem

An abandoned quarry near the west end of Corning, N. Y., filling with storm water and from melting snow, would discharge over the surrounding area, destroying gutters and overflowing catch basins. The Department of Public Works tapped the east end of the quarry and led the surplus water to a storm sewer discharging into the Chemung River. As Supt. of Public Works Philip Grannan reports: "We couldn't bring the quarry into the city limits by annexation; the quarry wouldn't come to us so we went to it."

Five Years of Fluoridation in 21 Municipalities

A study of the effects of five years of fluoridation in 21 municipalities in Monmouth County, New Jersey, by Drs. Ross and Hecht of the County Dental Society and Dr. Gleeson of the New Jersey Department of Health showed that, among elementary school children: (1) There was a reduction in the rate at which permanent teeth were attacked by dental caries; (2) there was a reduction in the number of permanent teeth presently requiring filling or extraction; and (3) there was an increase in the proportion entirely free from caries. Younger children benefited most.

Pedestrian Signals Timed For Safe Crossings

"Walk—don't run!" is the word for pedestrians from the Michigan State Highway Department's Traffic Division. WALK-WAIT pedestrian signals used on urban trunklines are timed to allow foot traffic to cross the street safely even though starting across a few seconds before the WAIT signal is flashed. The signals are set up to safeguard pedestrians and prevent them from being trapped on the crosswalks when vehicular traffic is given the green light. The restrictive WAIT signal is shown as soon as it is no longer safe for pedestrians to leave the curb. If the pedestrian starts to cross at any time during the WALK interval, he will have ample time to cross at a normal pace.

About 400 of the WALK-WAIT signals have been installed by the Highway Department on various urban trunklines throughout the state. They work in conjunction with regular traffic signals—halting pedestrians when cross traffic has the green light and vice versa. The signals serve a secondary purpose by allowing vehicular traffic to complete turning movements without interference from pedestrians. Highway Department engineers generally time the WALK-WAIT signals on the basis that the average pedestrian walks 3½ feet per second.

TAMPO SP-900 SPELLS HIGHEST QUALITY ASPHALT MATS!

Tampo's rugged SP-900 self propelled pneumatic tired roller provides GREATER GROUND PRESSURE than truck load limits for MAXIMUM DENSITY rolling. Check current specs in your state.

Higher unit pressures (exceeding truck tire contact pressures) densify the mat beyond traffic stress, tighten surface structure, prevent traffic grooving, decrease raveling and seal longitudinal joints.

- SURFACE PRESSURES ARE APPLIED WITHOUT DAMAGE TO UNDERLYING COURSES.
- TOTAL WEIGHT WITHIN AXLE LOAD LIMITS PREVENTS DAMAGING OVERLOADS ON HIGHWAY STRUCTURES.
- ACTUAL TIRE OVERLAP AT MAXIMUM INFLATION PREVENTS RUTS AND RAVELING.
- VISIBILITY AND MANEUVERABILITY ARE JUST RIGHT FOR INTERSECTION WORK.
- HIGH SPEED AND LOW COST PUT THIS ROLLER FROM JOB TO JOB FASTER, AND ON THE JOB AT BEST ECONOMY.

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SAN ANTONIO, TEXAS • PHONE PE 4-6621

RAIN BIRD *underground sprinkling systems*

Protect and enhance your landscape with an underground Nelson-Rain Bird Sprinkler System. Dependable and economical, an automatic sprinkler system frees maintenance crew labor for other work, reducing costs of landscape care. Accurately controlled sprinkling reduces shrubbery loss and keeps lawns healthy and green.
Consult your local Nelson-Rain Bird Dealer or write direct for complete information on Rain Bird Underground Sprinkler Systems.

Underground Rotary Pop-Up Sprinkler Systems

A complete selection of turf valves and underground sprinkling system equipment is available including portable hose sprinklers.

IN MIDWEST & EAST: **RAINY SPRINKLER SALES**
Division of L. R. Nelson Mfg. Co.
Peoria, Illinois

IN WEST: **NATIONAL RAIN BIRD SALES & ENGINEERING CORPORATION**
P. O. Box 547
Azusa, California

Rain Bird — Industry Standard For Over 25 Years

More mileage for your tax dollars

Specialist at Many Jobs

When you buy a "PAYLOADER" you get more than just a tractor-shovel. You get the most *proven*, also the most *useable* of tractor-shovels because of the most complete and unusual selection of attachments ever made available for *any* tractor-shovel. Included are several that are exclusive on "PAYLOADER" machines.

Reduces Your Equipment Costs

With one basic machine of broadest usefulness, you eliminate the big investment in specialized single-purpose machines. Then you continue to cut costs because you can keep a "PAYLOADER" busy more hours of the day and more days of the year. That is why we say it will pay you to see your Hough Distributor — soon.

PAYLOADER®

Back Hoe

Digs, swings, and dumps in 180° radius. Long digging reach, smooth, accurate operation. Installed or removed in a matter of minutes.

Blacktop Spreader

Lays hot or cold mix for patching or paving. Lays up to 8' widths and 0" to 6" thickness. Hopper capacity is two ¢ cubic yards.

Side-Boom

Lifts up to 10 tons at 4' overhang. Completely hydraulic control with telescopic boom reaching out to 16'. Cable drum has free spooling release.

a single machine gives you

4-in-1 Bucket

Most versatile bucket for many jobs. Hydraulically controlled, functions as regular bucket, bulldozer, clamshell or self-loading scraper. No end to its uses.

Vibratory Compactor

Four 30" shoes, equipped with individual electric motors, develop specified densities in granular soils. Self-contained easily attached and removed.

Fork Lift

Easily and quickly interchanges with bucket, to handle pallets of brick, loads of lumber, sheeting, etc. Spacing of forks adjustable. Hydraulic controls.

a construction equipment fleet

Snow Plows

Self-powered, self-contained rotary snow plows available for most "PAYLOADER" models. "V", one-way and reversible plows also available.

Leaf Loader

Picks up leaves and debris and discharges into truck. Cuts leaf handling costs by 30%. Will also handle light snow. Easily installed and removed.

Pick-Up Sweeper

Main broom and gutter broom hydraulically driven. Sweeps 6 to 7 ft. path. Can dump its accumulated loads directly into trucks or on street as desired.

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Send Bulletin "More Mileage for Your Tax Dollar" covering the complete "PAYLOADER" line and many useful attachments.

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"SADDLES ARE FOR HORSES"

...not American Cast Iron Pipe!

Too often the first cost of the material is the only factor considered when deciding between cast iron pipe or a substitute. To give sole thought to the cheaper substitute piping is, in a sense, false economy because many times this lower initial cost is misleading and obscures added expenses which must be incurred later.

Yes, the first cost may be cheaper... but cast iron pipe offers so much more.

Consider tapping. For reliable, economical water service, the tapped main must meet four definite requirements: (1) Have strength to withstand tapping operation; (2) Be of an *easily* tapped material which will assure *uniform* threads; (3) Have strength after being tapped to withstand service conditions; (4) Have threads that will provide tight connections after exposure to service stresses. *Cast iron pipe meets all of these tapping requirements.*

When tapping substitute piping, it is often necessary . . . to employ skilled workmen with special equipment . . . to utilize tapping saddles . . . to use extreme care in order to make a connection that does not leak.

Remember . . . tapping saddles are an extra expense and are *not necessary to make service connections to cast iron pipe.*

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CAST IRON PIPE CO.
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Ford 801 Series Powermaster tractor with heavy duty front end, Ford Extra Heavy Duty loader, Ford 12' backhoe.

FORD PRODUCTIVITY REPORT

Robert Rogers, owner
Handy's Trucking Co.,
Wallingford, Conn.

"I put a quarter-yard power digger in dead storage after I got my Ford"

Mr. Rogers reports: "I've had 5 years of backhoe work, and this Ford beats them all. I've got a truck-mounted cable type digger I can't even afford to use any more. The Ford works almost as fast, and doesn't cost near as much to operate. And I can take the Ford into places the bigger rig can't even go. I've got another tractor backhoe, too, but it doesn't compare with Ford. A job that takes 12 hours with the other backhoe, for instance, takes me about 8 hours with Ford. On this sewer job here, Ford will save me at least $75. I like Ford's undercutting, too. Went under a water main on this job and didn't shovel a wheelbarrow full of dirt. Never tear up a sidewalk any more. The only thing I can find wrong with Ford is that my other backhoe isn't one of them. And believe me, it soon will be."

Ford Motor Company

TRACTOR AND IMPLEMENT DIVISION • FORD MOTOR COMPANY • BIRMINGHAM, MICHIGAN

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Ford 1801 Series Industrial diesel tractor with Ford Super-Duty loader

FORD PRODUCTIVITY REPORT

George Kalinovik, manager
National Coal and Oil Co.,
Detroit, Michigan

"My Ford loaded 10,000 tons of coal last year—fuel cost about 2¢ a ton"

Mr. Kalinovik reports: "We load from 15,000 to 20,000 tons of coal a year—over half of it by loader into trucks or conveyor hoppers. This figures out at roughly 33 tons a day, from one to two hours of actual tractor work, and fuel for my Ford is about a gallon or 16¢ worth an hour. I can do five times as much work with the Ford as with my old loader. It's a much bigger bucket, and more important to me, power steering makes handling easy even where trucks have cut ruts in the yard. With the old loader, my arms got so tired they'd be shaking after I worked for a while. We load high-sided trucks we couldn't even reach before without a conveyor. We push rail cars wherever we want them. We even use the loader as a jack to change truck tires. We get all this with Ford—speed, big capacity, high dump, easy steering and low fuel cost. What more could you ask?"

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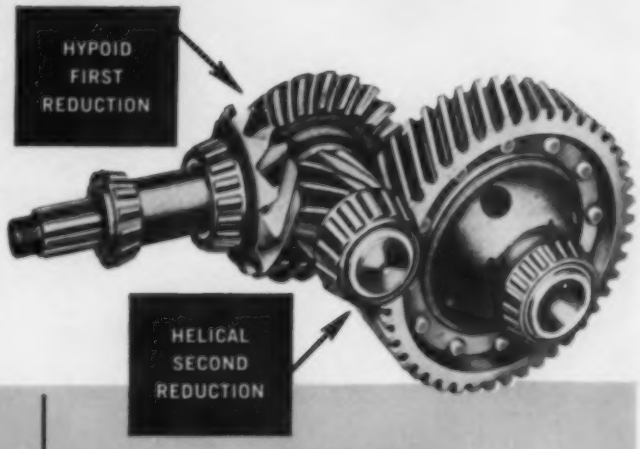
HYPOID-HELICAL DOUBLE-REDUCTION AXLES

Timken-Detroit balanced hypoid-helical double-reduction gearing is unequalled for top performance and dependability. Outstanding advantages that make it the choice of heavy-duty equipment manufacturers and operators are: big, husky gears . . . greater flexibility in gear ratios . . . balanced gear set loadings . . . long life and low maintenance costs. The hypoid first reduction is 30% stronger than spiral bevel, and works in series with the second reduction to take an equal share of the load. In the helical second reduction, strong helical gears with a wide range of ratios insure balanced double-reduction gearing.



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Two full-sized gear sets form a balanced power train—with each gear set accomplishing a substantial reduction. This combination of husky hypoid first reduction gears coupled with rugged, wide-faced helical second reduction gears provides a double-reduction gear set that outperforms all others. Because the ratios of each reduction may be varied, you get a balanced power train with the larger selection of axle ratios for maximum operational versatility and performance.

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TWO-SPEED, HYPOID-HELICAL DOUBLE-REDUCTION

A true two-speed axle which provides two separate gear ratios through the use of two full-size helical gear sets . . . a "fast" ratio for maximum speeds and a "slow" ratio for greatest pulling power. Pick the most efficient gear ratio to meet your requirements of speed, load and road. Spring-flex power shifting provides simple, positive shifting with either air, vacuum or electric actuation. Timken-Detroit two-speed hypoid-helical double-reduction axles give a versatility and economy to trucking operations that is unmatched by other axle gear designs.

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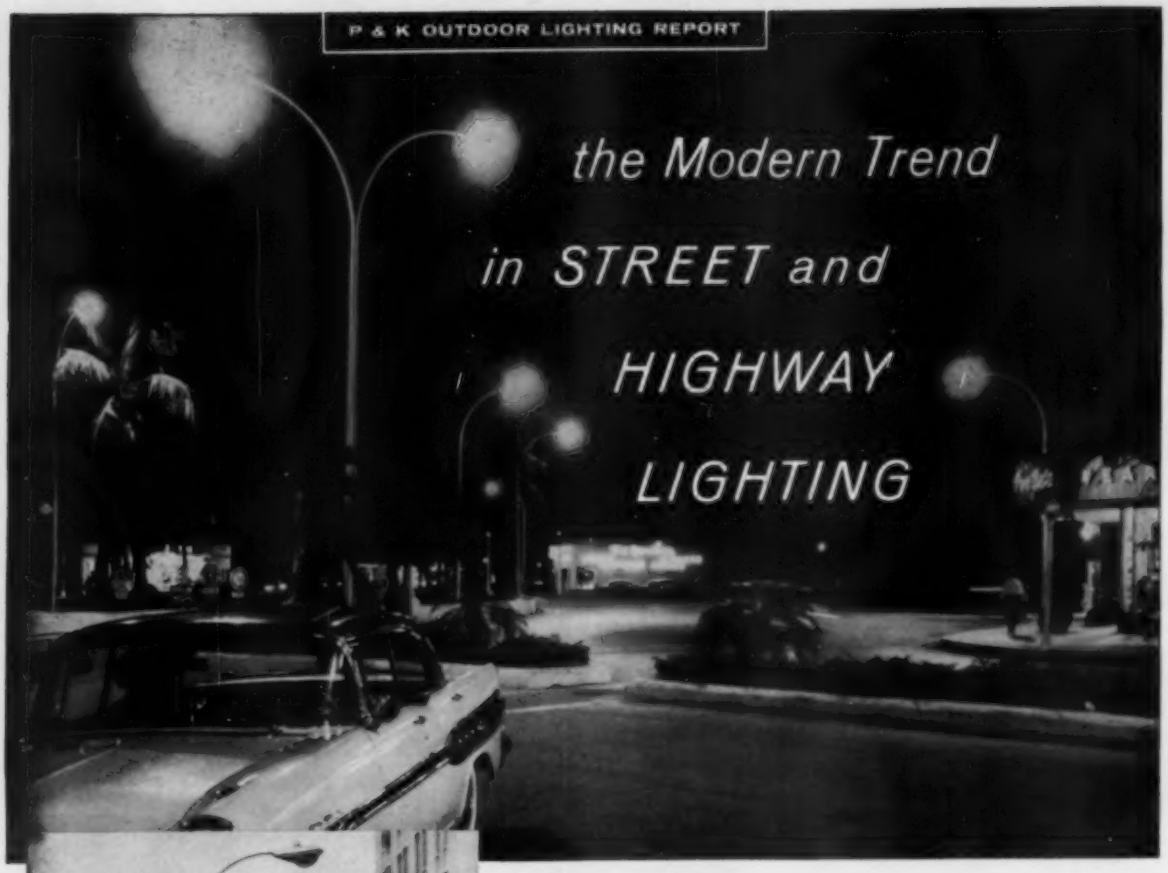
INTERCHANGEABLE BALANCED DOUBLE-REDUCTION DRIVES

Another Product of...

ROCKWELL-STANDARD CORPORATION

Transmission and Axle Division, Detroit 32, Michigan

P & K OUTDOOR LIGHTING REPORT



TOP PHOTO: Traffic circle illumination— West Miami Springs, Florida

LOWER PHOTO: New White Way—White Plains, New York

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More than just modern-looking, P&K street lighting standards are modern in total concept. Compare our use of functional design . . . no scrolls, no tie rods . . . instead a strong aluminum tapered elliptical arm — one piece for minimum inventory, fastest assembly and installation. Compare the P&K davit, truly the ultimate in functional design with a style as fresh as tomorrow. What's more, P&K is modern in the materials of construction: to the inherent strength and light weight of aluminum, P&K has engineered designs to meet every load requirement—from the conventional incandescent and mercury vapor luminaires to the new, larger and heavier models in both mercury vapor and fluorescent. And above all, P&K is modern in its elimination of maintenance problems. No painting required — ever. Even the salty sea air offers no hazard to the good looks of P&K standards.

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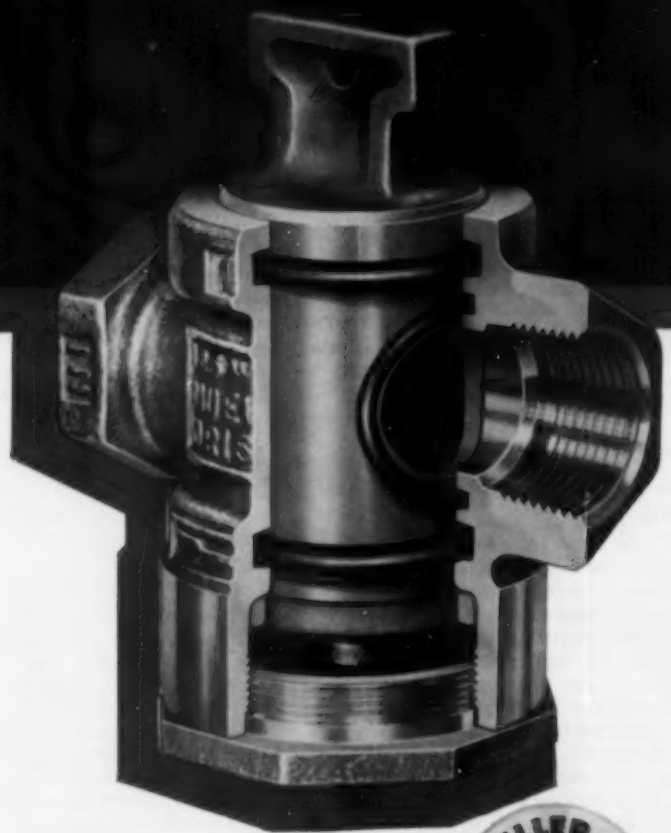

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pressure sealing "O"-rings provide positive sealing without mechanical seating device.

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Teflon-coated straight plug eliminates periodic maintenance.

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2" valves at 125 p.s.i. pressure easily operated with 12" wrench — even after prolonged idleness.

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20 years of laboratory tests, 12 years of field tests . . . survived 45,000 openings, closings without leaking, changing "O"-rings, or greasing!

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OVERHEAD or UNDERGROUND

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The unusual flexibility of the hydraulically operated HYDROCRANE crane, hoe, or shovel results in a use factor of almost 100% for many utilities and municipalities. For example, a midwest utility used its HYDROCRANE with interchangeable crane and hoe attachments on the following jobs within a span of a few hours.

Assignment: With clamshell attachment, digs 2½'x6'x11'-deep excavation for a sewer connection.

Why the HYDROCRANE? Highly industrialized area with many underground installations to work around. Digging here was too tricky for anything but hand shovels or a HYDROCRANE machine.

Excavation Completed — three hours.

Assignment: While workmen make sewer connection, the crane reports to overhead crew working four miles away. Helps install pole, steel platform and transformer.

Why Use the HYDROCRANE? Hydraulic, fractional-inch control eliminates most manual positioning of heavy equipment.

Installation Completed — one hour.

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Let your Bucyrus-Erie distributor show you how this hydraulic crane and hoe will keep busy for you all day — overhead, underground or on the level.

1H60

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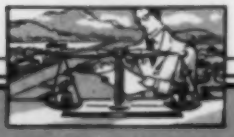
MOST RESPECTED NAME IN THE FIELD



LEGAL ASPECTS OF PUBLIC WORKS

MELVIN HORD, Dr. Eng. Sci., LL.B.

Sidewalk Defects

Becker v. City of La Crosse, 101 N.W. 2d 677, a Wisconsin case decided March 8, 1960, was an action by a pedestrian against the city for personal injuries sustained from a fall in a crosswalk on a city street.

The city denied that the crosswalk was insufficient, and argued that as a matter of law it could not be liable, since there was no abrupt difference in elevation anywhere exceeding 1.8 inches. The city sought to rely on several previous decisions of the Wisconsin Supreme Court which had held that a two-inch difference in elevation is not actionable as a matter of law.

The court held, however, that the question of the insufficiency or want of repair was a question of fact for the jury, since this was a hole 3.2 feet long in the direction followed by a pedestrian using the crosswalk, extending 1.0 foot into the crosswalk, with a rough and irregular bottom as much as 3 to 4 inches below the top of the pavement in some places. Thus, the fact that there was no abrupt change in elevation exceeding 2 inches was not in itself controlling in this case.

Drainage of Surface Waters

Randle v. City of Rome, 195 N.Y.S. 2d 373, a New York case decided Jan. 18, 1960, was an action by a property owner against the city for water damage to a residence allegedly caused when surface waters collected on the road and backed up onto her driveway and into her residence by reason of alleged inadequate and improper drain maintenance.

The city contended that (1) it could not be liable, as a matter of law, for the damage caused by the natural flow of surface water, even if this resulted from the grading of a street; and (2) there is no duty on the city to furnish drainage for water naturally collected on the street adjacent to plaintiff's property, nor is there liability for constructing a sewer or drain which proves to be of insufficient capacity to carry off ordinary surface water and rainfall.

The court, held, however, that while these rules are in general correct, nevertheless, the city could be liable if it collected surface water and cast it in a large and substantially increased amount on the lands of an adjacent owner. Therefore, where the city has undertaken to provide sewers and drains, negligence in the performance of the subsequent duties of keeping them in good condition and repair would render the city liable for the resulting damages.

The city's motion to discuss the case was therefore denied.

Extra Work—No Pay

Home Owners Construction Co. v. Borough of Glen Rock, 158 A.2d 197, a New Jersey case decided Jan. 28, 1960, was an action by a construction company to recover from a municipality for additional work and material allegedly provided in connection with a street improvement contract. Specifically, the plaintiff alleged, among other things, that during the course of excavation and the filling in of areas, the defendant's engineer requested him to do certain excess excavation in soft areas and to replace the removed excavation with stone, and that plaintiff did so, at a cost of over $5,000. Plaintiff was paid the amount due on the original contract, but not the additional amount claimed.

The court pointed out that a municipality, under New Jersey law, cannot enter into a contract exceeding $2,500 in amount unless the governing body advertises for bids and selects the lowest responsible bidder. Thus, if the claimed lia-

At Westchester County's New Rochelle Sewage Plant:

Bitumastic coatings still sound after 5 years service on concrete tank walls

Opened in 1955, the New Rochelle Sanitary Sewer District plant is designed ultimately to serve a population estimated at 81,000 by 1975. In designing for the future, County engineers of the Department of Public Works recognized the problem of plant and equipment protection: that's why they specified that certain areas in the plant be protected with Bitumastic coatings.

On the settling tanks shown, two coats of Bitumastic® Super Service Black were applied to all concrete surfaces to prevent erosion at the water line. On trash racks and other intermittently submerged metal surfaces, the same coating system was applied. A recent inspection after five years of operation showed that these protected areas still require no recoating.

Bitumastic coatings were used on the inside of four concrete digesters, too. A base coat of thick, heavy-duty Bitumastic No. 50 covered with Bituplastic® No. 28, a coal tar emulsion-type coating, helped to seal the domes of the digesters against the corrosive effects of condensation.

Sanitary engineers in all states are familiar with the proved protective qualities of Bitumastic coatings. For a booklet describing their specific applications in this field, use the coupon. Koppers Company, Inc., Tar Products Division, Pittsburgh 19, Pa. District offices: Boston, Chicago, New York, Los Angeles, Pittsburgh and Woodward, Ala. In Canada: Koppers Products, Ltd., Toronto.

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Gentlemen:

Please send me your booklet T93 on sewage plant protection with Bitumastic Coatings.

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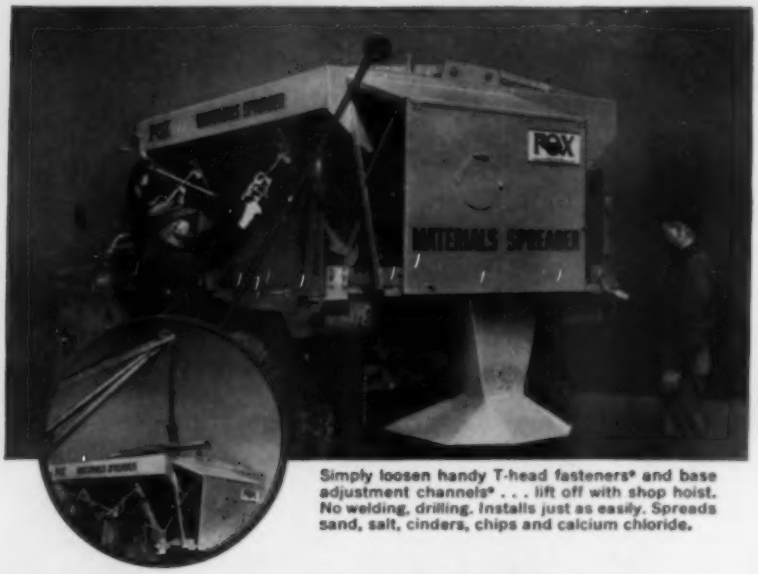
FOX spreader feature No. 1



Simply loosen handy T-head fasteners* and base adjustment channels* . . . lift off with shop hoist. No welding, drilling. Installs just as easily. Spreads sand, salt, cinders, chips and calcium chloride.

Unit on or off in 15 minutes—frees truck for other work

Ever have this problem? It's the middle of winter. Roads and streets have been plowed and sanded. But, there's a lot of snow to be removed and extra trucks are needed. Wouldn't it be great if you could use the sand spreader trucks? But no, they're tied up with spreaders year 'round. Invaluable when streets are icy . . . dogs when the weather is good.

The solution—Fox Mountable Material Spreaders! Four big, heavy-duty models ranging from 5 to 12 cu. yds. And, they install on any standard dump body in only 15 minutes (take 'em off just as fast). It's easy and economical. *You don't tie up trucks unnecessarily.*

You not only save on truck investment . . . but on manpower, too. Spreading with the Fox is a *one-man operation*. Dash-Mounted Electric Controls let him start the 18 H.P. spreader engine from inside the cab . . . set the spreading rate and operate the electric clutch. Heavy-duty auger feeds material to the spinner for a smooth even spread in widths from 8 to 40 feet . . . at any thickness desired, and at truck speeds from 5 to 40 miles per hour. Spreads *under* parked and passing cars, too . . . ahead of rear truck wheels for added traction.

To see all the Fox Features
ASK FOR A DEMONSTRATION

The Fox Materials Spreader will cut your labor, time and equipment expenses to the bone. A catalog . . . case history reports . . . even a no-obligation demonstration are yours for the asking. *Write, call or wire collect for the name of the nearest Fox distributor, who will gladly give you a demonstration.*

* Exclusive Fox patent.

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bility is on a separate contract, the claim is no good because the statute was not complied with as to the extra work. On the other hand, if the claimed liability is supposed to be under the original contract, it fails because the contractor failed to obtain an "extra order" from the engineer, as required by the contract.

Thus, the plaintiff was denied any recovery on its additional claim.

Garbage Dump Fire

Ethridge v. City of Lavonia, 112 S.E. 2d 822, a Georgia case decided Feb. 2, 1960, was an action to recover for fire damage to plaintiff's property, which resulted from fire spreading over a garbage dump maintained by the municipality.

The issue was whether or not the city was immune from liability for its tort (negligence or trespass).

The court held that the disposal of waste by a municipality is a governmental activity, which renders it immune from tort liability. However, an exception to such immunity exists when the damage is caused by the maintenance by a municipality of a nuisance.

The court held, however, that while the maintenance of a garbage dump in an improper manner can constitute a nuisance, there was no nuisance in this case. The damage was not caused by the maintenance of any specific condition on the city's dump, but was directly caused by a specific act which may have been tortious but which was not a nuisance.

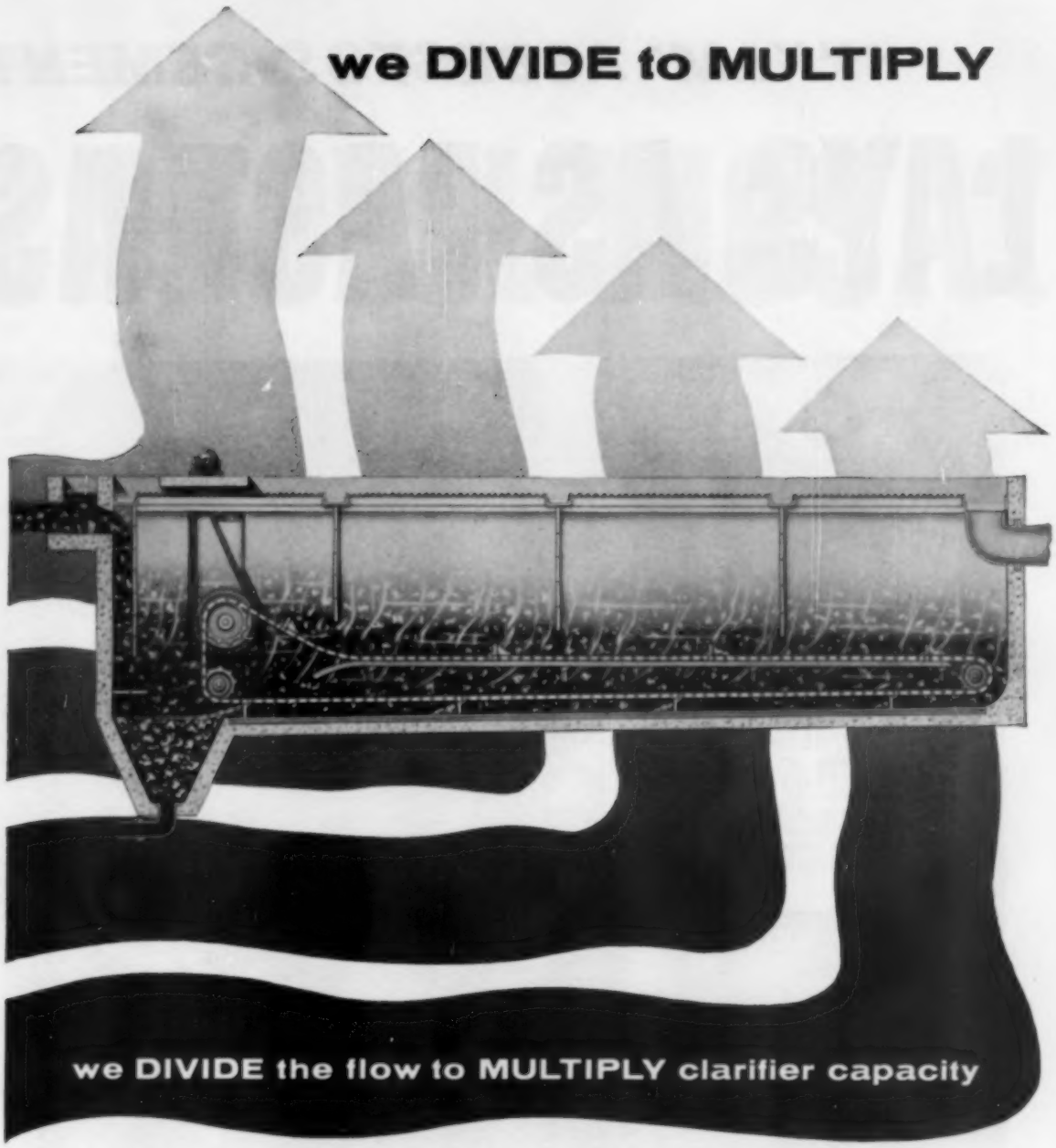
Therefore, the city's immunity barred any relief in this case.

• • •

Balance-Drive Mechanism for Clarifiers

The Patent Office has issued patent No. 2,931,241 to Charles H. Scott of South Norwalk, Conn., assigned to Dorr-Oliver, Incorporated, Stamford, covering the design of a hydraulically balanced drive mechanism for large and heavy structures which are rotated around a vertical axis. The improvement consists of hydraulically balanced application of torque at several points about the circumference of a large bull gear. At one point in the gear train in each of the drive mechanisms, the power is transmitted through a worm gear. The worm gear shaft is allowed a limited amount of movement longitudinally, and it is this longitudinal movement which is controlled by a hydraulic system

we DIVIDE to MULTIPLY



Rex Verti-Flo not only increases the clarifying capacity of tanks up to four times; it provides a far clearer effluent. The savings in equipment and construction costs are obvious. Here's how Verti-Flo does it: The unique design of Rex Verti-Flo Clarifier transforms the conventional horizontal-flow tank into a vertical-flow tank...utilizing the *full volume* of the tank and *minimizing short-circuiting*. This is accomplished by a system of collecting troughs, weirs and partitioning baffles which divide the large, horizontal settling zone into a series of small, vertical-flow cells. To assure maximum flow length and control, the weirs are adjustable entirely around the periphery of each cell.

Installed in existing tanks, Verti-Flo can be at least double the capacity of the tank...in new installations, Verti-Flo provides up to four times more capacity so that smaller basins can be used with considerable savings in both equipment and construction costs.

For information, write CHAIN Belt Company, 4722 W. Greenfield Ave., Milwaukee 1, Wis.

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"'K&M' ASBESTOS-CEMENT

LAYS AS FAST AS

Assembling 16" "K&M" Asbestos-Cement Pressure Pipe by hand without the aid of a bar. The backhoe merely steadies and aligns the pipe. The easy, two-step operation consists of (1) lubricating the tapered end of the pipe, and (2) sliding pipe into coupling.

PRESSURE PIPE

A SHOVEL DIGS..."

G&B Construction, Inc., Youngstown, Ohio, installs 4½ miles of "K&M" Asbestos-Cement Pressure Pipe for the Austintown District of Mahoning County, Ohio

"You can lay 'K&M' Pipe as fast as a shovel can dig. There is nothing that will hold you back with this pipe. When you can lay a 16" water line, and it goes in as easy as an 8" water line, what more could you ask? They've got a good joint with that FLUID-TITE® Coupling . . . the pipe is wonderful to put together. There is no comparison between the FLUID-TITE Coupling and other couplings. Of all the 'K&M' Pipe we've laid, we never had a coupling break. Coupling breaks are very common with other pipe."

Those are the comments of Louis Gulfo, partner with Mike and James Bertilacci in G&B Construction, Inc. They installed "K&M" Asbestos-Cement Pressure Pipe in bitter cold, during February and March 1960. However, neither rain, snow, nor mud interrupts the installation of this modern pipe. The exclusive, patented "K&M" FLUID-TITE Coupling and the simple fitting procedures required make assembly easy.

Little or no maintenance will face Mahoning County, which built and will operate the system for a year, or the City of Youngstown, Ohio, which will then take it over. Being non-metallic, "K&M" Asbestos-Cement Pressure Pipe won't rot, corrode, or tuberculate, and is immune to electrolysis. The suppliers of this pipe were Trumbull Plumbing Supply Co., Warren and Youngstown, Ohio.

Now, in addition, you may use quality "K&M" Plastic Pressure Pipe in the same system with "K&M" Asbestos-Cement Pipe, if desired.

Write today for more information on "K&M" Asbestos-Cement Pressure Pipe to: Keasbey & Mattison Company, Ambler, Penna. Dept. P-770.

K·M
BEST IN ASBESTOS

Keasbey & Mattison at Ambler

Left to right: Louis Gulfo, G&B Construction, Inc.; Dale MacCleary, sales manager, Trumbull Plumbing Supply Co.; James Bertilacci, G&B Construction, Inc., Burke Lyden, Asst. Chief Engineer, Youngstown, Water Dept., Jim Bisciglia, Asst. Engineer, Mahoning County, and J. Henry Painter, Trumbull Supply Company.

3 miles of 16" "K&M" Asbestos-Cement Pressure Pipe were installed. Here, we see it ready for installation along Webb Road, in Austintown Township. In branching from the 16" water line, Mahoning County used 1 mile of 12" "K&M" Asbestos-Cement Pressure Pipe and ½ mile of 8" "K&M" Asbestos-Cement Pressure Pipe. Specifications call for 90 lbs. pressure when line is in operation serving 16,000 residents.

Cathodic Protection

BRUCE J. ENNIS
Principal Engineer,
Burns & McDonnell Engineering Co.
Kansas City, Missouri

MOST OF THE corrosion of underground metallic structures is caused by the electrochemical processes which take place due to the flow of electrical direct currents set up in the structures from galvanic action in the metals themselves, or by stray currents from external sources. In most cases, the corrosive effects acting on buried structures do not become apparent until a gas or water pipe line ruptures at a corroded spot in the pipe wall, or a pole line down guy slackens off after the anchor rod has been eaten away, or a buried steel conduit is destroyed from the insidious action of corrosion.

A familiar example of an electrochemical process is the galvanic cell of a battery, in which the anode is the electrode from which direct current positive charges or ions flow out of the metal into the electrolyte and thence to the electrode called the cathode, while negative charges or electrons are flowing through an external metallic circuit from the anode, to rejoin the ions at the cathode and reform into atoms. In this process, the positive ions formed from the atoms of the metal of the anode migrate into the electrolyte, thus corroding or eating away the anode metal. The cathode is not subject to such corrosion since the positive ions of matter in the electrolyte flow into, and not away from the metal of the cathode.

In an analogous manner, the copper ground rod on a distribution pole line forms the cathode of a galvanic cell in which moist conducting earth serves as the electrolyte and a local or remote anchor rod acts as an anode. When an external electrical circuit is completed through the down guy strand from the steel anchor rod to the neutral conductor, and thence through the grounding wire to the copper ground rod, a battery action develops which causes a flow of positive ions from the metal of the anchor rod into the moist soil electrolyte, causing the anchor rod to be eaten away by corrosion to eventual failure.

Many factors affect the rate of corrosion. Poorly aerated soils, earth which is highly alkaline or acidic and which contains moisture for electrical conductivity, form the most corrosive types of soils. In any given electric, water, or gas pipe line system, the past history of replacement of iron and steel pipes and conduits, anchor rods, buried tanks, and fittings is indicative of the corrosive nature of the soil in which they are installed.

Occasionally, a large diameter steel pipe or buried tank will become corroded or pitted on the outside at the bottom, especially when impurities are present in the steel to form galvanic cells. In such cases, the top of the pipe or tank, being surrounded by well aerated soil, acts as a cathode; the steel in the pipe or tank wall acts as the return conductor; and the bottom of the pipe, encased in moist, dense, poorly aerated soil acts as an anode from which the metallic ions are eaten away and diffuse into the soil electrolyte to cause pitting and failure. The same galvanic action might take place between the cathodic top and the anodic bottom of a steel anchor rod installed from a lower strata of moist, poorly aerated earth up to a higher, well aerated strata. A steel pipe line, extending longitudinally between corrosive soil areas, is likewise subject to corrosion even when it is not coupled with a cathodic material such as copper.

Many corrosion problems take place as a result of the inter-galvanic action between two dis-similar metals, surrounded by a corrosive soil, and which are interconnected locally or remotely by a metallic path to serve as a return circuit to conduct the negative charges or electrons from the anode to the cathode, while the positive charges are flowing out from the anode through the soil electrolyte to the cathode.

Tables of the electromotive force for a series of metals as tabulated in handbooks indicate the relative potentials produced by electrode materials encased in an electrolyte, as well as the replacement or corrosive effects of the metals relative to each other. Thus in the following series, any of the metals listed will replace any other metal listed below it in the series; provided, the metals are in a corrosive environment:

Metal	Relative Potentials
Magnesium	Negative
Aluminum	Negative
Zinc	Negative
Iron	Negative
Lead	Negative
Hydrogen	Zero
Copper	Positive
Silver	Positive

By reference to this table, it is apparent that the more negative metal, magnesium, will corrode to protect a less negative metal such as iron. In this case, the magnesium is anodic with respect to the iron. Similarly, the negative iron will corrode to protect the positive copper as described above in the case of steel anchor rods and copper ground rods installed in a corrosive soil with an external metallic circuit interconnection.

The characteristic protective value of magnesium for most other metals has led to its widespread use as sacrificial anode material to afford cathodic protection to underground structures such as steel, gas and water mains. Such magnesium anodes, buried in the earth and connected to the pipe by insulated wire, freely discharge positive ions of current into the earth from the magnesium and put an excess of electrons onto the steel pipe, thus reducing the positive ion flow and resultant corrosion from the steel pipe and changing it from an anodic electrode to a cathodic electrode. In affording such cathodic protection to steel structures, the magnesium anode is sacrificed, or eaten away, at a rate in proportion to the amount of current it discharges.

In lieu of sacrificial anodes, a negative potential can be imparted to the steel pipe by means of an AC-DC electrical rectifier connected between the pipe and an outlying

EATON PLANETARY DOUBLE REDUCTION AXLES

SAVE WEIGHT
LAST LONGER
REDUCE MAINTENANCE

- **FIRST REDUCTION** in bevel gears
- **SECOND REDUCTION** in planetary gears

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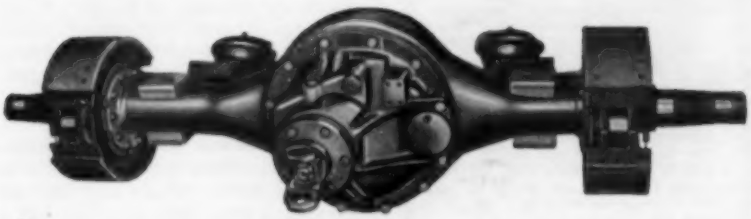

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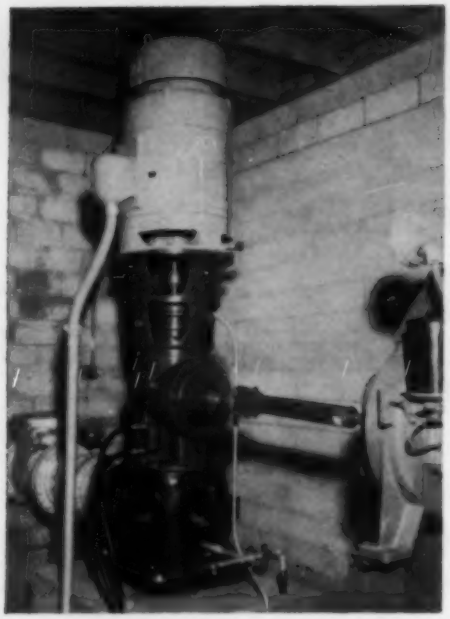

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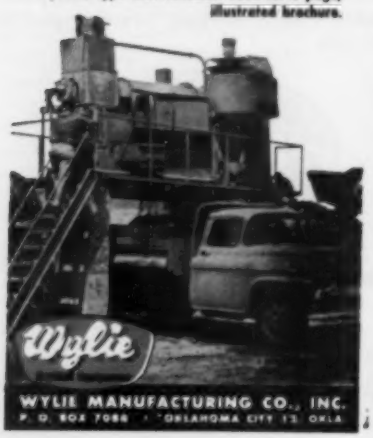

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It is possible for system construction and maintenance employees to detect the flow of current associated with galvanic corrosion by means of a DC milli-voltmeter having sharp probes or clamps connected to its leads, (which are connected to a section of the pipe or guy wire under test), and to take steps leading to the reduction of corrosion of buried metal structures. However, it is apparent from the above that the complexity and inter-relation of the many factors affecting galvanic corrosion warrants the services of corrosion specialists to provide a reliable and economical solution to the problem of providing cathodic protection for systems in which corrosive damage is in evidence or is suspected.

Considering the large investment required for the original installation of buried utility system structures, and the costly repairs that become necessary after corrosion has taken its toll, it is economically desirable for most systems to conduct tests and inspect sections of such structures to determine whether or not cathodic protection measures are indicated as necessary.

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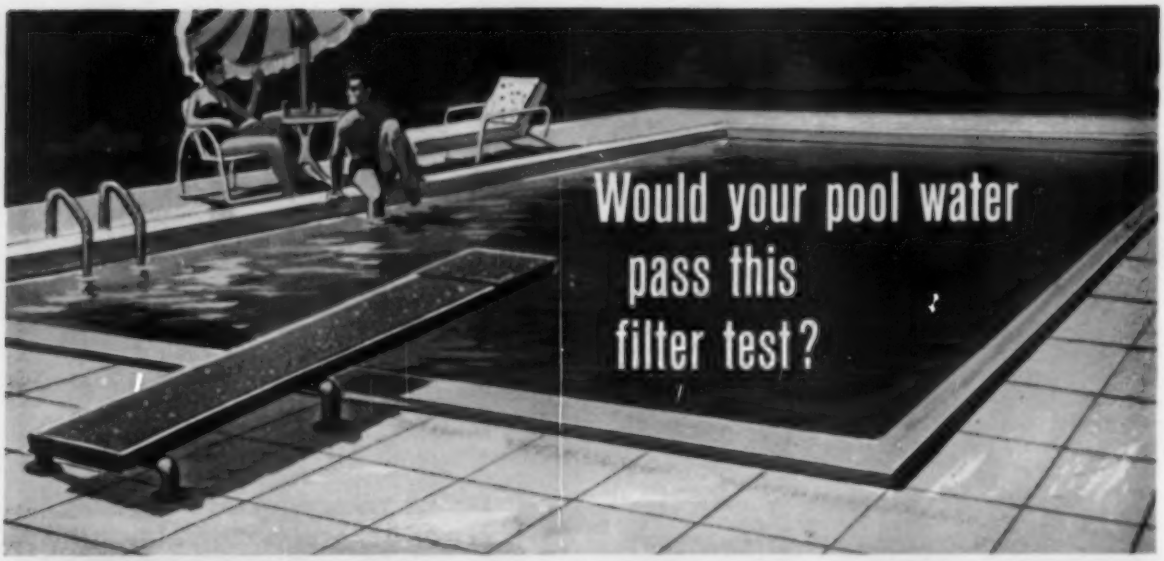

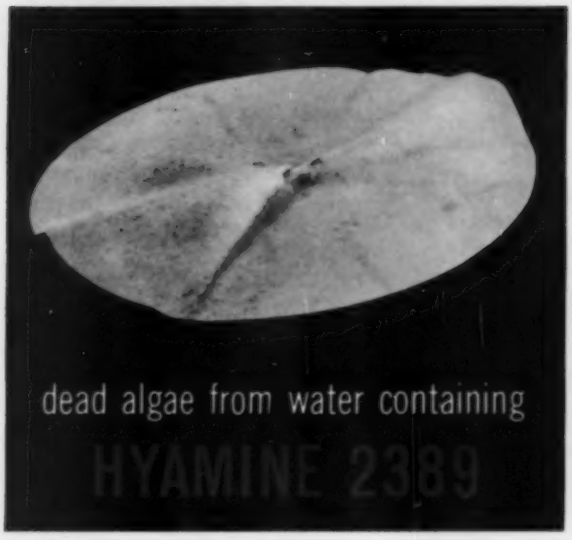

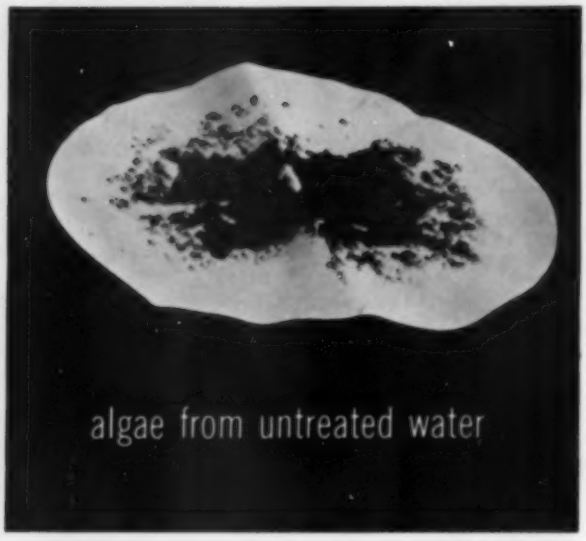

These filter papers show the remarkable results of a controlled laboratory test on algae growth. Just three ounces of untreated water, when poured through the filter paper on the right, produced the amount of algae shown. The same amount of water treated with algae-killing HYAMINE 2389, poured through the filter paper above, left only slight evidence of dead algae. Proof positive that regular treatments of HYAMINE 2389 can keep your pool free of slippery, unsightly algae. Helps you save money by cutting down on your use of chlorine, eliminating filter plugging and other maintenance due to algae growth. Formulations based on HYAMINE 2389 also make excellent disinfectants for use in locker rooms. Mail the coupon for information on local brand name products based on HYAMINE 2389.

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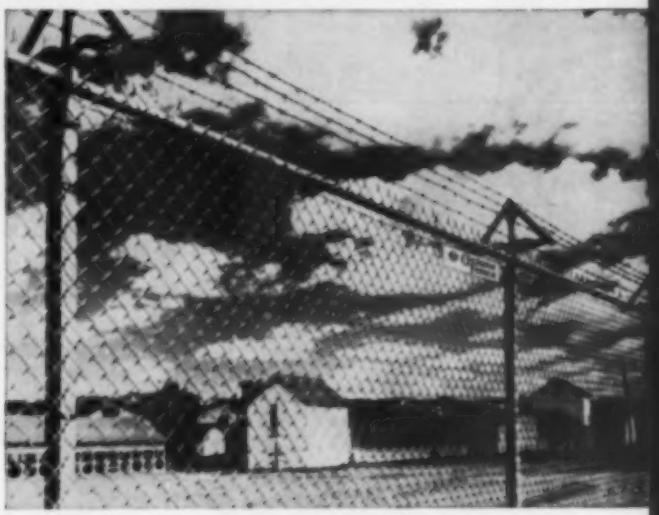
Corrosion Test. More than 10 years ago this panel of Cyclone Steel Fence was installed 45 feet from the ocean. Even in this extremely corrosive atmosphere it is still strong and serviceable. Cyclone Fence owes its unusual corrosion resistance to its heavy coating of zinc.



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In addition, according to previous cost records, a 1956 model No. 12 had been operated by the county for 2,524 hours without repair to the clutch. Total repair costs for the machine had been less than a dime an hour.

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PUBLIC WORKS MAGAZINE

Vol. 91, No. 7 • JULY 1960

SELECTED REPORTS on RESEARCH in SANITARY ENGINEERING

Research is no longer the handmaiden of scientific progress—it leads the band. It has become increasingly evident that research must precede solution of the environmental problems created by our complex society. That its importance is recognized is apparent from the five-fold increase in funds spent on sanitary engineering research in the last five years, although the total is still far from adequate. The need for research workers is as critical as financial support. In 1959, of those principally engaged in sanitary engineering research only about 125 were engineers. Making young engineers aware of the career opportunities available should result from a growth of graduate education in the field and from strong support from the profession.

Dr. Daniel A. Okun

RESEARCH INSTITUTES— — — PAST, PRESENT and FUTURE

The Research Triangle Institute

GEORGE R. HERBERT
President,
Research Triangle Institute,
Durham, North Carolina

PRIOR to World War II the spectrum of research activity in the United States consisted of fairly narrow, sharply delineated bands representing scientific group efforts. At one end of the spectrum, universities were engaged in a relatively small amount (judged by 1960 standards) of basic research directed primarily toward the creation of new knowledge or the training of graduate students. Next in the spectrum, a group of federal and state agencies maintained laboratories engaged in both fundamental and applied research. In the next band (a very narrow one, indeed) only two organizations had established their positions as independent, non-profit research institutes. These were the Mellon Institute of Pittsburgh and Battelle Memorial Institute in Columbus, Ohio.

The widest band in the spectrum encompassed the industrial laboratories of the nation's larger corporations. Their research was generally product-oriented or directed toward improved manufacturing processes. Though representing the largest research activity in the nation, even this band of the spectrum had been narrowed twice during the 30's by the short-sighted management belief that painless economies could be achieved by reducing or abolishing research budgets.

During World War II, national survival demanded mobilization of the country's scientific and engineering talents. The military departments of the federal government became the dominant research buyers. This war-born reliance on research and development skills stimulated a pace of scientific activity which has shown no sign of slackening in the years since World War II; and the easily defined differences between basic research, applied research and engineering, consulting and testing groups never have been re-established.

Many universities and colleges discovered a new dependence on government research contracts and grants to supplement faculty salaries and general administrative budgets. Government laboratories,

particularly those of the military departments, have continued to expand, and their activities range from pure, fundamental research to engineering design and testing.

Accepting the fact that future competitive position—and perhaps economic survival—depended on new products and improved efficiency, larger corporations increased research budgets and upgraded the organizational position of their research departments. Many of these corporations in turn, recognized that the continuing high level of defense budgets presented an opportunity to merchandise contract-research on a permanent basis and established separate divisions or new subsidiaries to undertake military research or engineering contracts.

Many smaller corporations, also recognizing the necessity of keeping pace with the accelerating technology, established research departments. Industrial research became the most rapidly expanding "industry"; and, for a period, research was in danger of becoming a corporate "fad." In spite of these occasional disenchantments, however, industrial research, and its resultant benefits, expanded at an almost unbelievable pace in the decade following World War II. We find approximately 1000 independent consulting laboratories listed in the 1958 edition of the National Science Foundation's "Directory of Independent Commercial Laboratories Performing Research and Development."

A New Trend

Perhaps one of the most significant developments occurred in the spectrum band labelled "not-for-profit, public-service, research institutes." Seven important organizations joined Battelle Memorial Institute and Mellon Institute, and in the first post-war decade, achieved maturity both in size and in service to their scientific and economic communities. The nine non-profit research institutions are: Armour Research Foundation, Chicago; Battelle; Cornell Aeronautical Laboratory, Buffalo; Franklin Institute Laboratories, Philadelphia; Mellon; Southern Research Institute, Birmingham; Southwest Research Institute, San Antonio; Stanford Research Institute, Palo Alto, Calif.; and Midwest Research Institute, Kansas City, Mo.

These nine institutes, unique both in corporate form and in the breadth of scientific services rendered, currently are engaged in research activities representing annual expenditures in excess of $125,000,000 and employ more than 10,000 staff members. There are, of course, many additional "non-profit research corporations" not included in this discussion.

The success of these organizations in providing large-scale, diversified research services has occurred in a period during which universities have assumed an increasingly important role in the nation's total research effort. The inevitable result has been the birth of a new type of research organization: the university-oriented, non-profit research institute. As an example of this category, the Research Triangle Institute of North Carolina will be described with special reference to the distinction between "university-oriented" and "university-owned," since many older institutes fall into the latter category.

The non-profit research institutes were created to perform a public service by stimulating the application of scientific technology to the problems of governmental units and foundations; and by conducting, with their own funds, basic and public-service research of the type not susceptible to outside sponsorship.

They do not provide routine testing and analytical services. These functions are performed only as may be required by complex research problems. They do not, in general, render opinions nor perform management consulting services. Research institutes provide fact-finding scientific, engineering and economic research.

Though there are many differences in capabilities and operating methods within the group, there are enough similarities to permit some generalization. These are organizations which maintain the professional research staffs and related facilities necessary to undertake a wide variety of research problems. Sponsored research is performed under the terms of a contract or grant agreement, and the size and variety of staff and skills available permit a "team approach" to the solution of research problems.

Contracts for research provide for reimbursement of direct costs (labor, supplies, travel and special equipment); payment of "overhead" (indirect costs and general administrative support); and usually a fixed or percentage fee. The total charges, therefore, cover the organization's operating expenses and provide a modest income which is used to finance basic and public-service research, to permit upgrading the institute's facilities, and to provide small reserves necessary for inevitable operating fluctuations. As non-profit organizations, of course, the institutes cannot use net income for the benefit of individuals or groups of individuals.

Institute Programs

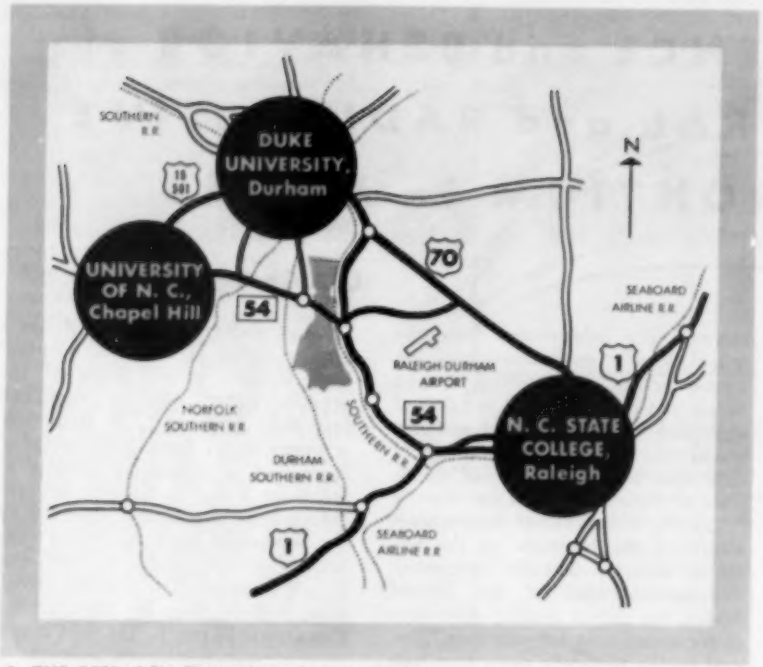
The range of the research interests and capabilities of these nine institutes is evidenced in the programs, divisions or scientific fields listed in their annual reports.

In the air pollution and water resources fields, are found the following types of projects:

Removal of constituents of stack gases: "in connection with its fluorine problems . . . is assisting the company in designing a recovery system." (Stanford Research Insti-Institute, 1958 Report)

Study of toxicity of compounds in public water supplies: "A bibliog-

● **LOCATIONS of nine principal non-profit, public service research institutes.**



● **THE RESEARCH TRIANGLE. Central shaded area is site of new Research Park.**

raphy on the toxicity of boron compounds in public water supplies was prepared . . . (and) . . . led to a recommendation on the limits of boron content that might be permitted to be discharged into public streams." (Southern Research Institute Report for 1958)

Area development studies involving factors related to proper utilization of water resources: "Surveyed water requirements and potential economic supply, with sufficient purity, quantity and reliability for Air Force Base in arid southwestern United States." (Armour Research Foundation, 1958 Report)

". . . the study includes an economic evaluation of the effects of differences in quality of water available for agricultural, industrial and household purposes in a large area in California." (Stanford Research Institute, 1958 Report)

Air pollution: "As a public service, Armour Research Foundation has been analyzing since 1946 the dust fallout samples collected by the Chicago Department of Air Pollution Control. The data are correlated, where possible, with local weather phenomena and with business activity." Also: "Levels and major sources of air pollution . . . investigated to provide basis for an abatement program." (Armour Research Foundation, 1957 Report)

Development of radioisotope techniques to trace effluent flow downstream. (Research Triangle Inst.)

How do the objectives and functions of the newer form of research institute, the "university-oriented" non-profit institute, differ from those of the older group? To the casual observer, there is little difference in surface indications. As an example, the Research Triangle Institute of North Carolina, though newer (created at the end of 1958) and in the early stages of development, maintains its own staff and facilities and performs grant and contract research in a number of scientific fields. The differences, and they are significant, are found in some of the underlying objectives and in the basic relationship with one or more universities.

The difference between "university-ownership" and "university-orientation" perhaps can be most clearly demonstrated by the type of university membership represented in the research institute's corporate organization. With university-ownership the institute's governing board may be elected by University trustees and often will be drawn from among friends, business associates and major contributors. In other cases, the trustees themselves may serve on the institute's governing board. As individuals, however, they are still representative of the financial, business, or industrial community.

In contrast, effective control of a university-oriented institute's board will rest in the hands of academic officials whose experience and interests are directly related to the educational and scientific activities which provide the environment for development of the associated research institute. The Research Triangle Institute provides a clear example. Created as one segment of a broader program which combines the efforts of leaders of universities, business and the State to increase research activity in North Carolina, RTI was established as a separate non-profit scientific research corporation.

Academic officials of the three Triangle Universities represent 50 percent of RTI's board members. In addition to the respective presidents, these members include vice-presidents, chancellors, graduate deans, and department heads and provide a close degree of cooperation with the universities.

A second measure of the difference is found in the extent to which university faculty members participate directly in the activities of the research institute. Although an institute is university-owned, there may be no established procedure for faculty participation in the institute's research activities; or the absence of mutual interests may result in little faculty participation. The university-oriented institute is created to develop scientific programs which will supplement and complement campus research. The necessary close degree of coordination results in a constant interchange of interest and ideas for the benefit of both groups. In the case of the Research Triangle Institute, every new division or laboratory has been created with the active cooperation of university faculty members, and their continuing interest expands the capabilities of RTI's own research staff.

Expressions of interest and inquiries from other universities, particularly in southern and southeastern states which constitute the new economic frontier of the 1960's, would seem to indicate that the Research Triangle Institute may establish a pattern for a new group of "university-oriented" research institutes. The nine older research institutes, now recognized as constituting a special category of research facilities, grew and flourished in the post-war era. The next decade provides an opportunity for the new type of scientific research institute to utilize fresh combinations of research talent in the expanding application of science and engineering to regional and national growth.

OCCURRENCE and BEHAVIOR of NATURAL and RADIOACTIVE STRONTIUM in WATER

M. W. SKOUGSTAD
and
F. B. BARKER
Research Chemists,
U. S. Geological Survey,
Water Resources Division,
Denver, Colorado

Part of the studies on which this paper is based were supported by the Division of Reactor Development, U. S. Atomic Energy Commission.

IF RADIOACTIVE STRONTIUM should enter a stream, one of the factors which will determine its ultimate disposal is the amount of natural nonradioactive strontium already present in the water. The usual chemical analysis does not include a strontium determination; nor do the usual methods for determination of calcium discriminate between calcium and strontium so that any strontium present is included in the calcium value. There is no simple chemical method for determining strontium, primarily because of the difficulty of separating relatively small amounts of strontium from much larger amounts of chemically similar calcium and magnesium. Hence there are very little available data on the amount of strontium in water. The U. S. Geological Survey is currently conducting a survey of the occurrence of strontium in surface and ground water of the United States.

Water samples from about seventy selected sites distributed throughout the United States are being collected and analyzed for strontium content. The samples represent major rivers and drainage areas of the United States and, for the most part, are taken at locations that are included in the regular sampling program of the U. S. Geological Survey. In addition to the determination of strontium on each sample, a comprehensive chemical analysis for the major constituents of the sample is made.

Three samples are taken at each sampling site, to coincide with high, median, and low flow stage of the stream. The information thus obtained permits an evaluation of the concentration of strontium to be found in the stream, the relation of strontium content to streamflow conditions, and the relationship of strontium to other dissolved materials at various flow stages.

Certain observations and generalizations can be made on the basis of analyses already completed. Throughout most of the United States, the rivers contain strontium in concentrations varying from several tenths to rarely more than one mg/L. Rivers of the Southeast and the Pacific Northwest contain very little strontium; in many streams the concentration is less than 0.1 mg/L. An area where surface water contains relatively large amounts of strontium (often several mg/L) is found in northern and western Texas, western New Mexico and Oklahoma.

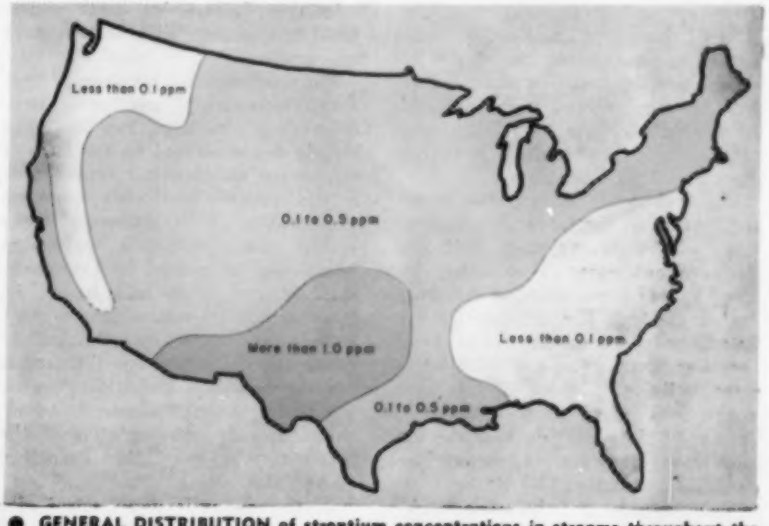
In addition to the collection and analysis of samples from the major rivers of the United States, more than 200 samples of ground water, collected mainly from public water supply wells throughout the nation, have been analyzed for strontium.

U. S. Geological Survey

Ground water, in general, shows a greater range of strontium content than surface water. Some of the ground water samples contained less than 0.02 mg/L of strontium, whereas water from some wells in Iowa had a strontium content as much as 8 mg/L. Several investigators have previously reported on the unusually high strontium content of ground water in east-central Wisconsin. The highest strontium content thus far reported for this area is 52 mg/L. Oil field brines may contain significant amounts of strontium, sometimes exceeding 100 mg/L.

Ion-exchange Properties

The ion-exchange properties of natural substances are important in that they affect the dispersal in the hydrosphere of radioactive substances released to the environment. Certain alumino-silicate minerals, including glauconite, zeolites and the various clay minerals, exhibit cation-exchange properties. Metal ions adsorbed by mineral particles can be exchanged for cations in the solution in contact with the mineral. Thus, cations may be removed from



● **GENERAL DISTRIBUTION of strontium concentrations in streams throughout the United States, as determined by sampling programs of the U. S. Geological Survey.**

solution by exchange and adsorption on the particles of suspended matter in the stream, solid material of the stream bed or the mineral material in a subsurface aquifer. The Geological Survey is investigating the ion-exchange properties of certain minerals, particularly with respect to trace concentrations of the more hazardous radio-nuclides, including strontium-90.

The clay minerals are the most common of natural ion-exchange materials and are responsible for most of the ion-exchange capacity of rocks, soils and water-borne sediments. For this reason, five typical clays were selected for study. These are all American Petroleum Institute reference clays: kaolinite No. 4; illite No. 35; halloysite No. 12; montmorillonite (white) No. 11; and montmorillonite (bentonite) No. 21. These clays represent four different lattice types and also a wide range of exchange capacities, varying from 10 milliequivalents per 100 grams for the kaolinite to 140 milliequivalents per 100 grams for the bentonite.

Several methods for determining the total cation exchange capacity of minerals were studied. Two, an ammonium chloride method and a radiocesium method, have been selected as being the most useful for these investigations.

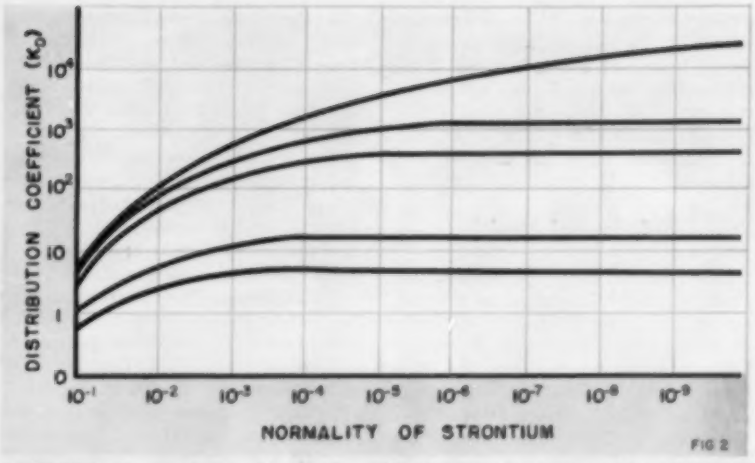
The ammonium chloride method is believed to be the best of those generally available and is widely used as a reference method for determining total exchange capacities of clay minerals. The radiocesium method is more economical of the chemist's time and is useful over a wider range of total exchange capacities than is the ammonium chloride method. It is, therefore, preferred for most routine determinations. The amount of cesium adsorbed by the clay is determined by comparing its activity with that of the standard cesium solution used for the equilibration. The total exchange capacity is expressed as milliequivalents of exchangeable ion per 100 grams of clay.

The amount of a trace constituent that is adsorbed by the clay is conveniently expressed in terms of a distribution coefficient, K_d, defined by

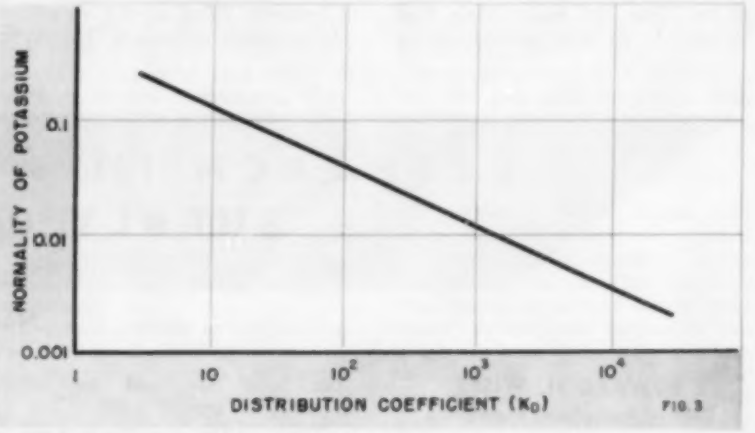
$$K_d = \frac{f_s}{1 - f_s} \cdot \frac{V}{M}$$

where,

f_s = fraction of adsorbed ions
V = volume of liquid phase
M = mass of solid phase



● **EFFECT of strontium and potassium chloride concentration on the adsorption of strontium on clay. The series of curves represents different potassium concentration, ranging from 0.2 N for the lowest curve to 0.002 N for the uppermost curve.**



● **DISTRIBUTION coefficient for the adsorption of trace amounts of strontium on montmorillonite clay is affected by the concentrations of potassium in the system.**

Several factors influence the value obtained for the distribution coefficient for any given clay mineral and a given trace constituent. Most significant of these factors are the original concentration of adsorbable cation, the original form of the clay with respect to adsorbed cations and the concentration of other cations in the equilibrium solution. Distribution coefficients for strontium with each of the five clays have been determined experimentally over a concentration range of from 0.2 to about 10^{-10} N in the presence of calcium, magnesium, sodium or potassium, whose concentration was varied from 0.2 to 0.002 normal. These ions were selected because of their general occurrence in natural water.

Experimental determination of the distribution coefficient is made by equilibrating the mono-ionic form of the clay, which has been ground to pass a 200-mesh screen, with a solution of selected composition with respect to stable ion and the radioactive adsorbable ion, and then calculating the fraction of strontium adsorbed from a measurement of the activity of the clay or the solution. Equilibrium is considered to be achieved after a minimum of 12 hours of continuous shaking. Measurement of the activity of the solution is simple since it involves merely centrifuging or filtering the sample to separate the clay and withdrawing an aliquot of the solution for counting. When the activity of the clay is to be measured, it must be separated by centrifuging and be freed of its excess ions by successive washings with ethanol. Whether the activity of the solution phase or the clay is counted depends on the distribution of activity between the two. When 50 percent of the activity is in each

phase, it makes little difference which is counted. Otherwise, when small fractions are adsorbed it is preferable, for maximum accuracy, to count activity of the clay. Conversely, when adsorption is large it is preferable to count that of the solution.

Radiological Health

The rate of travel of radiostrontium injected into surface or ground water will depend in part on reactions involving exchange of strontium between solution and the suspended or consolidated sediment in contact with the water. Data of the type described above are needed in order to predict the concentrations and time of arrival of contamination anywhere down-gradient from the point of injection. The concentration of strontium in most surface water is less than 10^{-4} molar (less than 10 mg/L). At these concentrations, the distribution coefficient is virtually independent of strontium concentrations, but is influenced by the concentration of other major constituents of the water, for example, calcium or sodium. It would, therefore, be possible to predict the amount of adsorption on the basis of the concentrations of the major chemical constituents of the water and the amounts and species of minerals in the sediment load.

Typical experimental results may be shown by the data obtained for the system strontium-potassium chloride-montmorillonite No. 11. These data are shown in Figure 2. The graph shows clearly that the distribution coefficient increases with a decrease in the concentration of either ion. Of particular significance is the fact that the distribution coefficient for a system of constant potassium concentration approaches a constant value as the strontium concentration decreases. Moreover, this limiting value for infinite dilution of the strontium is proportional to the concentration of potassium in the solution, shown in Figure 3.

The wide range of concentrations of adsorbable ion studied as a part of these investigations have provided a basis for greater understanding of the ion-exchange process and its role in the geochemistry of minor elements in water.

The biological uptake of radiostrontium by plants, animals and man depends, in part, on the concentration of stable strontium and the strontium-to-calcium ratio in the environment. Knowledge of the occurrence and distribution of strontium is essential in order to evaluate the seriousness of radiostrontium contamination in a given area. This information is also of importance as an aid in the selection of sites for radioactive waste disposal where there will be a minimum of hazard to mankind.

RESEARCH IN WATER SUPPLY PREDICTION

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INCREASED use of irrigation in North Carolina requires more satisfactory information than has previously existed regarding water supplies for agricultural use from ponds and streams. Also, as demands for water increase from expanding municipalities, industries and irrigation, accurate information concerning potential supplies will be necessary over large parts of the State.

The United States Geological Survey conducts an extensive program of stream gaging in the State. However, general applicability watersheds and many of the gages have insufficient lengths of record to be statistically reliable. While generalized relationships have been developed to predict minimum flows on streams with short or discontinuous records, no such relationship has been developed for either monthly or annual yield.

There is, on the other hand, a rather dense network of precipitation stations. It seems desirable to consider an approach by which this large volume of data could be used to estimate runoff. The existing runoff data could then be applied to determine parameters required by the method and to test the predicted results.

A number of methods of predicting the water balance have been developed in recent years, based on the simple relationship: Precipitation (P) — Evapotranspiration (ET) + Change in soil moisture content (ΔS) = Excess (EX). These methods vary in complexity depending on the assumptions used in the computation.

The simplest method of computation as used by Van Bavel (1) is to calculate average values of ET for each month over large areas using the Penman equation. A continuous daily calculation is carried out. When the soil moisture content reaches zero, ET is assumed zero. When the soil moisture content reaches a specified maximum value, any surplus is considered excess.

Other assumptions have been suggested by Thornthwaite and his colleagues (2, 3). Daily rates of ET are calculated using mean temperature. These rates are adjusted for the relative soil moisture content (5). An estimate of surface runoff is subtracted from precipitation before inclusion in the balance (6).

The relationship between excess and runoff is not so readily obtained, since it depends on factors characteristic of the location, such as soil type, sub-surface flow conditions and topography. In some areas, snow may be an important factor. Van Hylckama (3) has been able to predict runoff with a fair degree of accuracy for small watersheds in the Delaware River watershed.

The Water Balance

Development of the proposed method for predicting runoff may be divided into two related problems:

a) Analysis of existing methods

for estimating the water balance, directed toward testing of the results and use of the most accurate assumptions.

b) Modification of the estimated values of excess to estimate runoff, and statistical analysis of the results for prediction of water supply.

An accurate water balance should provide information on soil moisture content, drought or excess conditions and excess amount. While a given set of assumptions might be satisfactory for estimating any one of these factors, it would appear that a method that would estimate all of them would be most useful.

Such a method would also allow more checking of the basic assumptions. For example, because of the problems involved in relating runoff to excess, runoff data are not useful in checking assumptions involved in computing evapotranspiration. Data available on drought conditions or soil moisture content are more suitable for this purpose.

One of the characteristics of hydrologic analysis is the large amount of computation required, particularly where daily values of the water balance are obtained. For adequate statistical analysis, 25-year periods are being used and over 30 stations covering the Piedmont and Coastal Plain areas of North Carolina have been selected. Thus, even for the simplest assumptions, a great deal of computation time wou'd be required. As the assumptions used become more complex, the time is increased considerably.

Digital computers have proved extremely useful in reducing the burden of computations. Various assumptions that would be too complex for manual computation may be programmed for solution by computers. This requires that the data be on cards, punched paper tape or magnetic tape. The Weather Bureau is currently processing

● **UNIVAC installation at Chapel Hill which is being used for the computations.**

weather records on punched cards, and these decks are readily available. Unfortunately, card input on most computers is relatively slow, and it seems advisable on large projects to convert the cards to magnetic tape whenever possible. The development of the Fosdic process involving conversion from a standard format such as cards, to microfilm and then to magnetic tape will be useful as direct input to the computers.

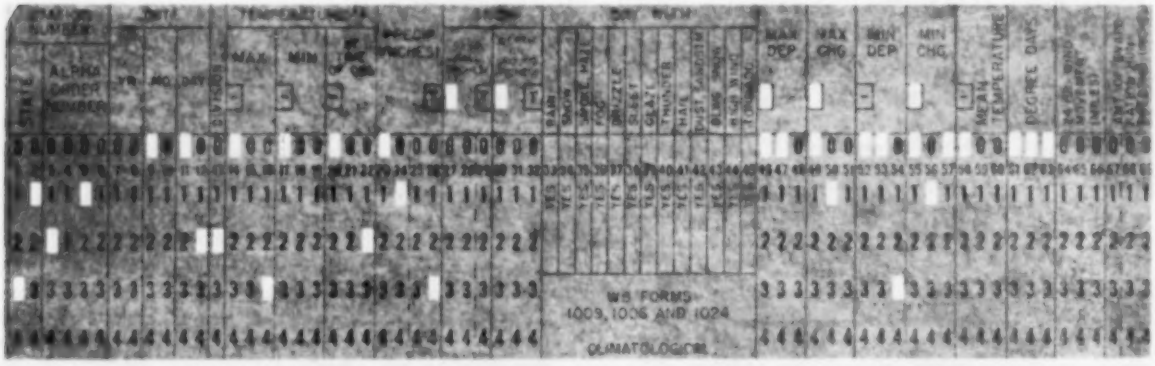
The next problem is the development of generalized programs for use on the computers. A flexible program has been developed by Engelbrecht (4) for use on the IBM 650 using either the Van Bavel or Thornthwaite assumption and including a correction for surface runoff. Several programs have been developed by the author for use on the Univac 1105. One such program involves four different computation methods at four different soil moisture storage levels. Complete analysis for a 25-year period for one station takes 15 minutes, a job that would take almost a year by hand.

Such programs, once developed, may be used quite generally, with the proper parameters being applied for the specific problem.

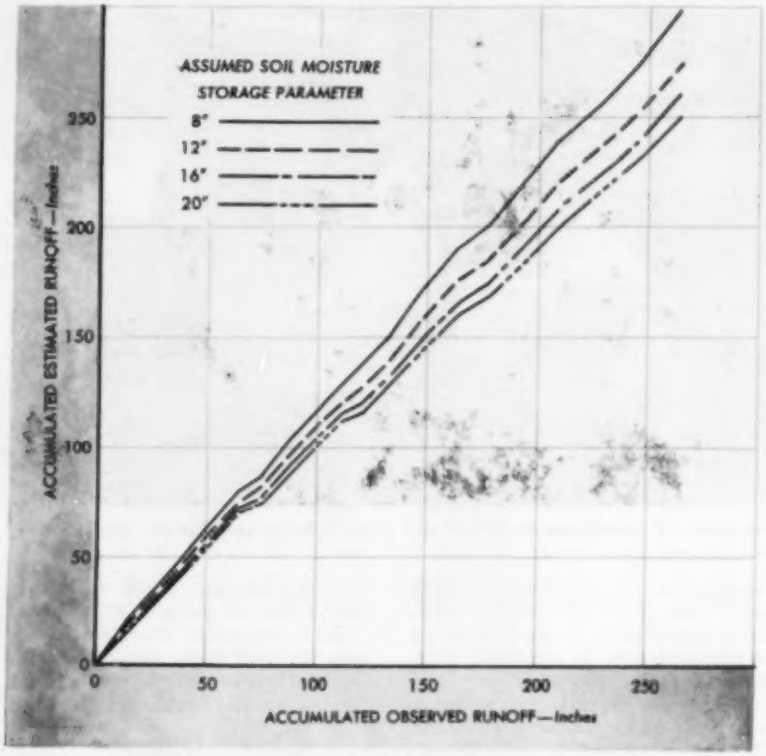
Runoff Estimation

In regard to water supply, past work has been directed toward analysis of the assumptions of the basic water balance. The output of the balance is excess rather than runoff; considerable lag exists between the time that excess is available and the time that it actually runs off. However, the annual runoff from a large watershed should match the annual excess computed over the watershed, especially if plotted as a double mass curve.

This has been tested for a number of watersheds in North Carolina with good results. The slope of the line is a function of the maximum soil moisture capacity used in the computation. By selecting the value for this parameter which yields a



● **CLIMATOLOGICAL, rainfall and evaporation data are punched on standard Weather Bureau cards for use in computer.**



● **MOST SATISFACTORY storage parameter results in a curve on the 45° line.**

45-degree line, an estimate of soil moisture capacity can be made. This, in turn, will permit an accurate prediction of annual runoff where similar soil type, topography and plant cover are likely to result in the same soil moisture capacity. Present work is directed toward evaluating the maximum soil moisture capacity parameter for a number of watersheds with widely different conditions.

Future research will be directed toward estimation of runoff, both projecting backward for testing, and projecting ahead for predicting water supplies. With this information, a more accurate distribution of surface water supplies to municipalities, industries and agricultural users can be made.

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CORROSION CONTROL IN POTABLE WATER SYSTEMS

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CORROSION control is of tremendous significance to the water works profession, particularly in the soft water areas of the Atlantic and Pacific seaboards, and also in many households using zeolite softened water. Research has been carried out for the past eight years in the Sedgwick Laboratories of Sanitary Science at M.I.T. on the mechanism of corrosion (1) and corrosion control (2) in steel pipes. The objective has been to develop the most effective and economical means of controlling corrosion in municipal and domestic water piping.

Several aspects of corrosion control were investigated. These included the use of chemicals such as caustic soda (3), metaphosphates (4) and silicates (3), the use (or misuse) of so-called water conditioning devices (4)(5)(6), and fundamental studies of the fluid mechanics involved in metallic corrosion in water lines and corrosion control (7). One phase of this research will be discussed in this paper —a study of the relative effectiveness of caustic soda and sodium silicate.

Methodology

Answers to this problem had to be found in the laboratory because funds were limited and field work is expensive of time, labor and materials. It is known that the over-all reaction in the corrosion of iron is:

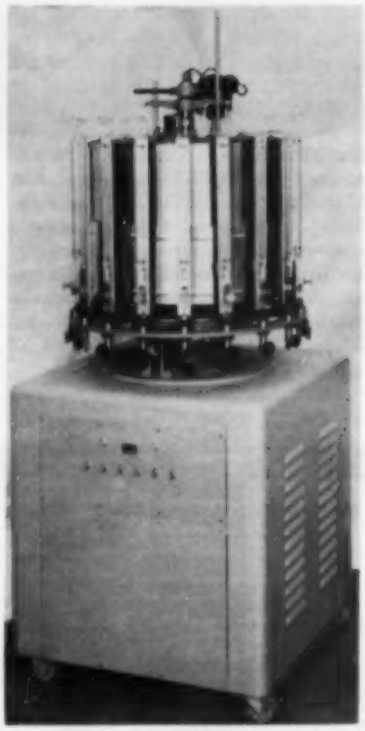
$$4\,Fe + 3\,O_2 + xH_2O \rightarrow 2\,Fe_2O_3 \times H_2O$$

Since the oxygen is supplied from the water, there is a depletion of the oxygen content of the water. Measurement of this depletion, or oxygen consumption, is widely used as an index of corrosion.

There are various ways of employing the oxygen consumption test. The so-called "oxygen drop" technique consists generally of determining the dissolved oxygen of the water before and after exposure to the metal in long pipelines. Some researchers prefer to rotate the specimens in liquid of known oxygen concentration, and measure the oxygen concentrations at the end of the test. Others use a disc specimen fully immersed in water with oxygen in the space above the liquid. Use of oxygen from the space above the sample was taken as the rate of corrosion, but the apparatus for each individual sample was complex. In view of the above limitations on the oxygen depletion testing method, a more flexible and rapid technique for measuring the rate of oxygen absorption by nondestructive testing of the sample was sought. This resulted in the studies using the Warburg respirometer.

Corrosion testing methods based on manometric measuring of oxygen consumption have the advantage of giving complete corrosion-time curves from a single specimen. Since these curves are usually smooth, the effect of various environmental conditions on the corrosion rate with time can be investigated by noting the oxygen depletion as often as desirable. Manometric devices or respirometers of various types have been used extensively in the study of the biological degradation of organic wastes. The chief advantages of the Warburg respirometer are the extreme flexibility and speed by which many variables can be studied in short term tests.

The Warburg method of measuring oxygen utilization is based on the change in pressure of a constant volume system resulting from the uptake of oxygen from that system. The reaction flask, containing the specimen and partly filled with corrosive solution, is attached to a manometer of which the fluid has nearly the same specific gravity as water. With the Warburg in operation eighteen such reaction flask and manometer systems are immersed in a constant temperature



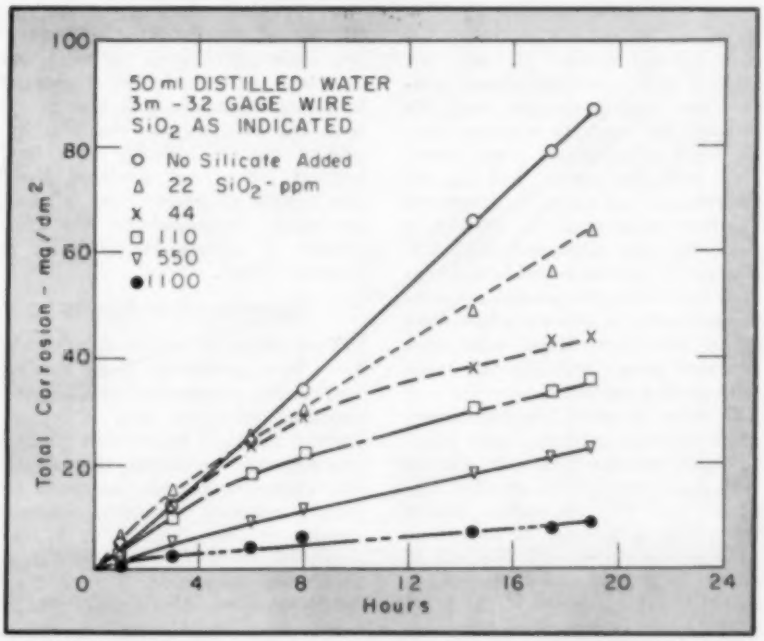
● **FIGURE 1. Warburg respirometer was used for corrosion rate studies.**

water bath. Constant motion of the specimens in the corrosive solution is maintained by an oscillating device. This action also agitates the surface of the water which insures free diffusion of oxygen from the atmosphere above the sample to the liquid as it is being utilized. The large number of reaction flasks used simultaneously presents an opportunity for the study of many variables under controlled conditions.

As oxygen is absorbed in the corrosive water to form oxidized corrosion products, it is replenished to the solution from the atmosphere above in the reaction flask. The oxygen uptake causes a reduction of pressure above the fluid which is measurable on the manometer. Pressure variations in a system due to changes in temperature and atmospheric pressures are compensated for by a thermal barometer. Oxygen utilized at the time of a reading may be computed readily from the net pressure change.

Fine grade steel wire was used as corrosion specimens. With a diameter of 0.008 inch, the wire provided sufficient surface area for rapid uptake of oxygen, which was accurately measurable by manometric means. The wire was made from normal low carbon steel with the following percent composition: Fe = 99.5; C = 0.10; Mn = 0.25; P = 0.04; and S = 0.05. The specimens were pickled in 5 percent hydrochloric acid for 4 minutes at 25°C prior to the tests.

The steel wire samples were placed into 50 ml. of water in the reaction flasks, which were of 125 ml. capacity. To facilitate handling of the specimens, they were coiled into spirals. With the gently oscillating action of the Warburg respirometer, the samples were in con-



● **FIGURE 2. Silicates have a tendency to depress the corrosion rate of iron.**

stant motion within the flasks. The constant temperature water bath was maintained at 20°C for the corrosion tests. Periodic oxygen consumption measurements were then made over the desired test intervals.

Results of Tests

First it was desired to show whether silicates really worked. Studies were carried out to show the correlation between actual weight loss of the steel sample and oxygen depletion. An average variation of only 8 percent was observed. In the data which follows, corrosion is expressed in terms of milligrams per square decimeter (mg/dm^2). Fig. 2 presents the results of adding various concentrations of sodium silicates (water glass) to the water. These results indicate greater corrosion inhibition with increased silicate content over a 19-hour test period. No attempt was made to maintain constant pH in the silicate treated samples, with the result that the pH ranged from pH 6.0 in the untreated distilled water blank to pH 10.0 in the 1100-ppm silica solution. The degree of corrosion inhibition varied from 28 to 89 percent over the range of silicate concentrations from 22 to 1100 ppm. These tests were repeated using Cambridge tap water, with similar results.

In order to settle the controversy as to whether silicates were effective only because they were alkaline and raised the pH or whether silicates had true corrosion control properties, a number of tests were carried out to obtain the results shown in Figs. 3 and 4, the former at pH 8 and the latter at pH 9.

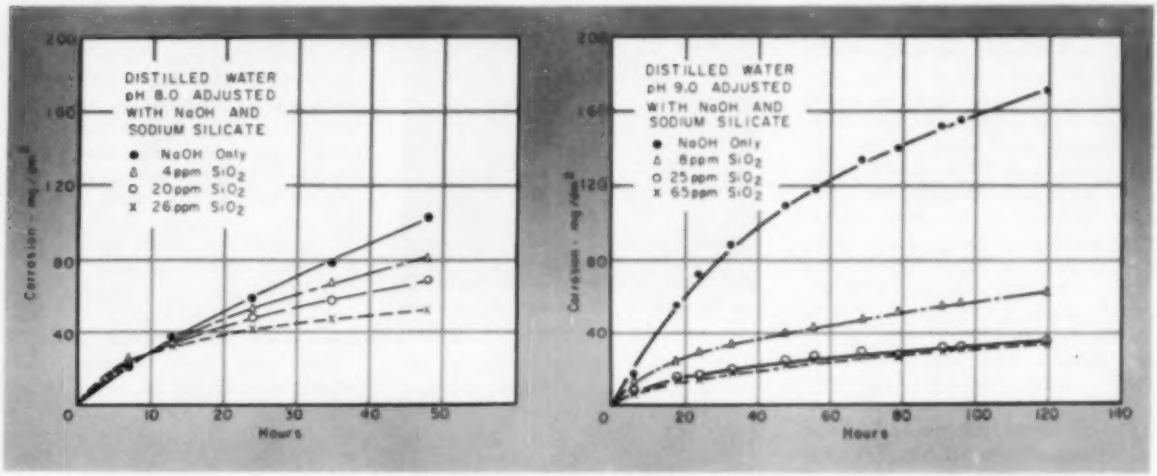
Different silicate concentrations were obtained by adding silicates with $Na_2O:SiO_2$ ratios of 1:1, 1:2 and 1:3.3. The very alkaline 1:1 ratio silicates attained the desired pH level quickly with little SiO_2 present, while more silicate was added to reach the same pH level using the less alkaline compound. The results of the tests at pH 8.0, shown in Fig. 3, indicate clearly the inhibitory effects of increased silicate concentrations as compared with sodium hydroxide solutions having the same pH. After 48 hours of corrosion, the inhibition obtained in the 4, 20 and 26-ppm silicate solutions was 20, 34 and 49 percent respectively.

In studies at pH 9.0, much more effective corrosion inhibition was obtained with increasing amounts of silica. These results are shown in Fig. 4. A most striking difference was observed between the corrosion rate in a pH 9.0 solution of sodium hydroxide as opposed to that in an identical pH solution obtained by adding sodium silicate. This important factor, not disclosed from the results of other types of experiments, indicates that the efficiency of silicate inhibition is a function of pH.

Significance of Results

Two items of major significance have been proved by these studies and many supporting studies not reported here for lack of space. First, it has been shown that a modern scientific technique of analysis, the respirometer, can be used to obtain accurate corrosion control results at less expense in a less cumbersome apparatus and in a much shorter period of time than other oxygen depletion methods commonly used in corrosion studies.

Secondly, these results point to the greatly increased corrosion control obtained with silicates over that with caustic soda, or pH control alone. However, pH does play an important part in that silicates are much more effective at pH 9.0 than at pH 8.0. These results will have to be verified in the field on actual distribution systems, but the indications are that significant corrosion control in steel water lines can be obtained by adding between 8 and 25 ppm of sodium silicate and maintaining a pH value close to 9.0. This is a very cheap chemical which is not difficult to feed with modern proportional chemical feeding devices. It is estimated that the cost of this type of control will range from 2 to 4 mills per 1000 gallons.



● **EFFECT OF SILICATES on corrosion of iron. Figure 3, left, at pH 8.0; Figure 4, right, at pH 9.0.**

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SODIUM CHLORIDE UPTAKE by ALGAE

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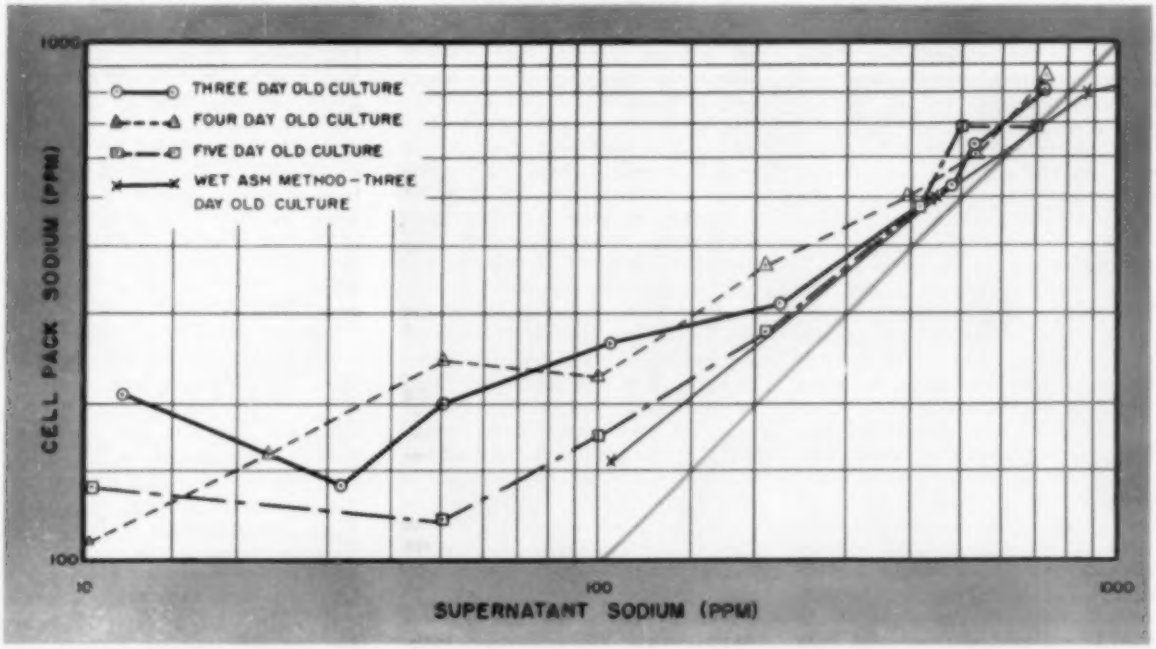
ALTHOUGH it is fundamental to life that all organisms constantly accumulate or exclude certain ions present in the environment, until recently little attention had been paid to the physiological mechanisms of ion transport from the standpoint of possible importance in the field of saline water conversion. In 1957, Resources Research, Inc. undertook a literature study to review the status of active ion transport by physiological mechanisms and to seek possible engineering implications.

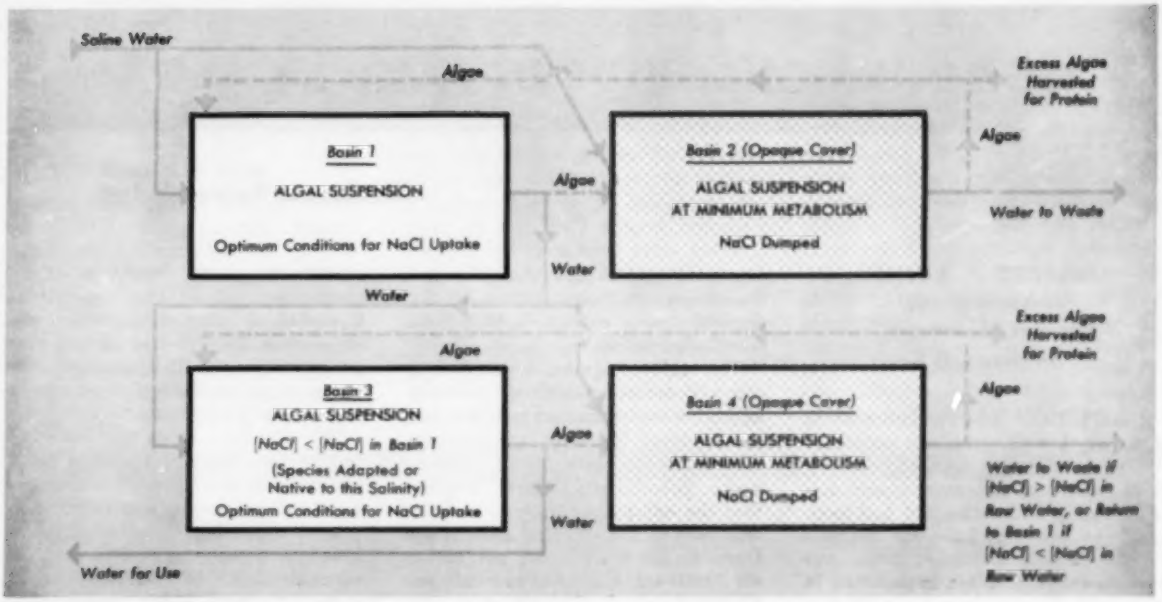
On the basis of available information, there seems to be a striking similarity in physiological mechanisms achieving and maintaining dynamic imbalance of various ions distributed between intracellular and extracellular fluid. Thus, many varieties of animals, plants and individual cells accumulate and maintain ions against considerable concentration gradients through the expenditure of energy derived from metabolic processes.

The ability of the isolated frog skin to transport sodium chloride against a concentration gradient has been studied by many investigators. The available data were used to make calculations which indicate that the energy requirements of the frog skin in transporting sodium are three to six watt-hours per gallon of 30,000 mg/L sodium chloride sea water desalted. This closely approaches the theoretical minimum of 2.8 watt-hours per gallon for the desalting of sea water by any possible means. For the conversion of sea water, this efficiency exceeds the efficiencies which might be achieved by conventional processes under development by a factor of twenty or greater. However, based on the rate of sodium transport by the frog skin, 227 square meters of membrane surface would be required to desalt completely one gallon of 30,000 mg/L sodium chloride sea water in one hour. To supply this much surface in a two-dimensional arrangement would be unwieldy. However, a three-dimensional arrangement, such as that afforded by a suspension of a finely divided material, might produce a more nearly practicable configuration.

The literature study had revealed that certain algae occurring in fresh water ponds were known to concentrate sodium against a concentration gradient. *Nitella*, for example, was found to produce a 46-fold internal concentration of sodium when grown in pond water containing 5 mg/L of sodium. If unicellular algae might concentrate sodium from brackish or sea water, a biological process of desalting might be feasible. An algae the size of *Chlorella*, with an average diameter of five microns, would provide the 227 square meters of membrane surface in 25 gallons of a 2 percent packed cell volume suspension of the organism. This concentration of cells could be maintained in a mass culture. Assuming that sodium ion transport by algae was in the same range of efficiency as that effected



● FIG. 1. Growth experiments performed on *Chlamydomonas* show organisms take up sodium from dilute solutions of sea water.



● **FIG. 2. Flow diagram for hypothesized use of algae in saline water conversion, showing arrangement for two-stage process.**

by the isolated frog skin, and that it might be possible for some species of algae to maintain approximately this efficiency in saline waters, one gallon of fresh water per hour might theoretically be produced by a 25-gallon sea water suspension of the organisms.

The meager information in the literature concerning the uptake of sodium by algae was confined to the analysis of several species as they occurred in natural fresh water ponds which were low in sodium content. Moreover, the physiologic reasons for the concentration of sodium which had been observed are unknown. Based on the information presented above and on the possibility that an algae might be found which would concentrate sodium in saline water, a method for using algae to desalt saline water was devised. A schematic layout for a continuous process is shown in Fig. 2. Algae would be grown in the first basin where an optimum environment for the uptake of sodium chloride would be maintained. After flowing through this basin, the algae would be mechanically removed to the second basin where an unfavorable environment would be maintained to inhibit reversibly the metabolism of the cells. Thus denied energy necessary to maintain their internal concentration of sodium chloride, the algae would secrete salt in approaching equilibrium with the environment. The algae would then be mechanically removed from the second basin and returned to the first to take up additional sodium chloride, gradually depleting the salinity of the water in the first basin as the cycling continued. The sodium chloride enriched water in the second basin would be wasted. Sodium depleted water would be drawn from the first basin for use or for introduction into a second stage of the process. Excess algae would be harvested for their protein content.

50 Species Studied

In order to determine the degree of sodium uptake that various species of unicellular algae might exhibit in waters of various salinities, a laboratory study was undertaken. Approximately 70 species of unicellular algae, both fresh water and marine, were obtained from various sources. Some 50 of these grew well enough under test culture conditions to permit their sodium and chloride uptake characteristics to be studied. Cultures for uptake studies were grown in test tubes containing appropriate dilutions of sea water medium. The test tubes were suspended in a 25°C constant temperature water bath and were continuously illuminated at an intensity of approximately 600 foot-candles of fluorescent light. Cultures were continuously aerated with 5 percent CO_2 in air. Zero time analyses for sodium, chloride and conductivity were made on each culture after its inoculation with the test species. At intervals, aliquots were withdrawn from the culture tubes. The portions were centrifuged and analyses for sodium, chloride and conductivity were made of the supernatant liquid or the packed cells or both. In this manner, the change in sodium chloride concentration between the cells and the suspending liquid was studied. Some of the cultures were grown for as long as two weeks and the appropriate corrections for change in liquid volume, as a result of evaporation or condensation, were made. Sodium analyses were made by use of the spectrophotometer with flame attachment. Chloride content was measured by titration and a conductivity cell was used to determine electrical resistance. The cell pack material was prepared for analyses by hydrolysis. The organisms tested were grown in concentrations of sea water ranging from several mg/L of sodium chloride to full strength sea water, depending on the range wherein the particular organism could grow.

Several unicellular algae were found to concentrate sodium chloride. The concentrations, however, occurred in low salinity waters. Generally speaking, the maximum sodium concentration in which uptake occurred was that corresponding to several percent sea water. From determinations performed on *Chlamydomonas* it was evident that, when grown in dilutions of sea water containing less than approximately 700 mg/L of sodium, the organisms did take up sodium. The 700 mg/L sodium level was con-

tained in a 7 percent dilution of Atlantic Ocean water. It is thus shown that, for the organisms studied, effective sodium concentrations do not occur in waters of sufficient salinity to be of practical significance. The data obtained, however, represented the first study of this nature and concerned only a small portion of the many unicellular species of algae which might be examined. The fact that significant sodium uptake has been established, and that this varies with different species, indicates that additional research on unstudied species and on physiological factors which might increase uptake, could result in enhancement of sodium uptake by biological means.

The study revealed several other interesting facts. Both fresh water and marine algae were found to grow in surprisingly wide salinity ranges. Some fresh water species grew well when placed directly in 50 percent sea water and some marine species were readily cultured in 25 percent sea water. Marine species which were easily cultured were found to exclude sodium to a marked degree. The possibility thus arises that marine algae might be mass cultured in sea water and harvested for protein which would not contain excessive quantities of salt. This, in effect, might provide a means for growing a "fresh water crop" in arid regions without actually desalting sea water and then applying it to the land.

Acknowledgments

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PESTICIDES and LAKE REHABILITATION

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DURING the past few years there has been a rapid growth in development and use of synthetic and naturally occurring organic chemicals in agriculture. There appears to be a trend toward use of synthetic organics or "synicides" to control plant disease, parasites and undesirable vegetation. Considerable quantities of these substances ultimately reach surface water supplies through runoff and irrigation return flows.

The highly toxic properties of many "synicides" to fish and other aquatic life have been subjects of considerable study. Little appears to be known about the physiological significance of such substances in drinking water supplies. It has been suggested that in some instances biochemical degradation byproducts may be of equal or greater importance than the original organic. Analysis and interpretation of the organic constituents found in natural waters, particularly in agricultural areas, are seriously restricted by a general lack of information regarding the biochemical behavior of these substances in natural waters.

In order to provide a basis for finding answers to some of these questions, research sponsored by the Public Health Service was initiated in the Sanitary Engineering Laboratories concerning the biochemical destruction of the major classes and types of "synicides."

Materials Investigated

According to available information more than 300 organic compounds have been developed commercially for use as pesticides. Available time and facilities do not permit a direct detailed study of each of these substances. A method of classifying these compounds was developed to serve as a basis for planning preliminary study. Examination of available information regarding chemical structure disclosed that most of the commercially significant pesticides are closely related chemically. Thus it appeared that preliminary information pertaining to a considerable number of substances could be obtained through study of a relatively few materials.

Pesticides representative of each major classification group were obtained from industry. Wherever

● **SAMPLING from a water column overlying Green Lake bottom sediment to determine uptake of nutrients under various biological and physical conditions.**

possible the substance studied represented an analytical reference grade sample of a so-called "best seller." At this time, approximately 30 materials had been studied including such well known pesticides as captane, chlordane, DDT, dieldrin, malathion, parathion and TEPP.

Method of Study

Preliminary information regarding the susceptibility of these compounds to biochemical oxidation, was obtained through use of the Warburg apparatus and by means of the standard dilution BOD technique. Aerobic cell tissue developed from a sewage-soil inoculum was employed as the biological media. Much of the preliminary investigation phase was concerned with response of non-acclimated cell tissue. It was reasoned that this would be representative of conditions in natural waters receiving sudden doses of pesticides such as might occur from flash floods and sudden runoff from agricultural areas.

Results

With few exceptions, the major classes and types of pesticides were found to be highly resistant to biochemical oxidation. Where significant oxidation was observed, it appeared to be centered mainly in acyclic side chains and groupings. As expected, halogen substitution and the presence of heavy metals either blocked or inhibited oxidation. Of the materials studied, only malathion appeared subject to rapid biochemical oxidation. Many substances were toxic or inhibitory at concentrations as low as 50 mg/L. In a few instances, acclimation of cell tissue was observed to occur within a two- to four-hour period.

Work recently began on acclimating cultures to relatively low concentrations of inert pesticide types. The nature of the biochemical oxidation by-products or end products resulting from biological attack is being studied.

Lake Rehabilitation Studies

Green Lake in Seattle has been a subject of continuing controversy since its purchase by the city in 1907. Controversial characteristics of the lake and what to do about them have been centered on problems of heavy algal blooms, pollution from domestic sewage overflow, storm water admission, swimmers itch, using the lake as a waterfowl refuge, fish propagation, littoral vegetation, bottom sediments (mud) and city water admission.

The lake has an enormous recreational potential that is now affected by alleged sewage pollution and alga growths. In an average year, the lake is used by 42,000 swimmers, 10,000 fishermen and boating en-

(*Continued on page* 182)

TOXICITY of SELECTED IONS on ACTIVATED SLUDGE TREATMENT

The Ohio State University

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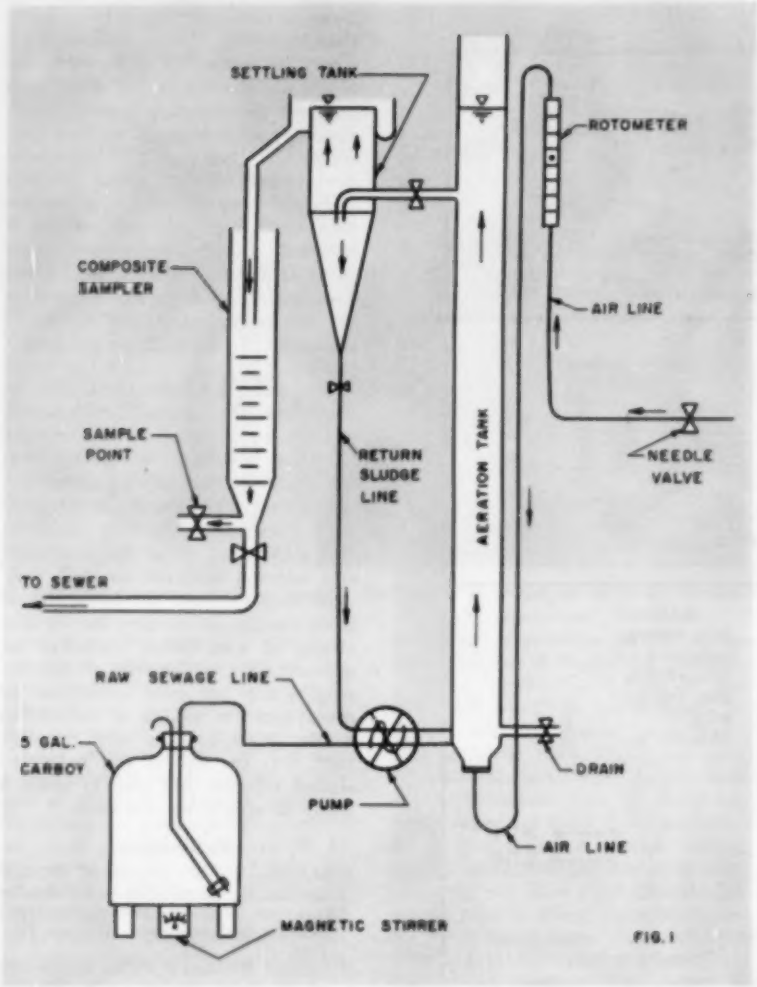
A MAJOR problem confronting the sanitary engineer in industrial areas concerns the toxic effects of various industrial waste products being discharged into sewers and watercourses. Little information is available on the singular and combined effects of these waste materials on biological metabolisms. For the past six years The Ohio State University has conducted a research program through the sponsorship of the Ohio State Department of Health involving the evaluation of effects of various selected ions on the biological stabilization processes. Obviously the problem has an enormous scope when considering the myriad of variables concerned. Organization and classification of these variables and their effects therefore become necessary in order to achieve comprehension of the problem. In general, the variables were divided into two groups: 1) The operational variables, including the type of biological treatment processes, and the "controlled" variables of each operation such as loadings, temperatures, recirculating rates, air application and physical characteristics of the several processes; and 2) the industrial waste variables, including waste strength and condition, and types, concentrations and combinations of the toxic ions present.

Our investigations to date have been limited to the effect on the activated sludge process of specific ions commonly found in the metal plating industry wastes, and which, there has been reason to believe, have deleterious effects. Past efforts have been directed largely toward the establishment of satisfactory test and analyses procedures, and the development of suitable laboratory-scale equipment. Wastes investigated included varying concentrations of chromium, copper, nickel, zinc, cyanide and cadmium. Experimental results were based on the direct manometric (Warburg) technique.(1) The results indicated a surprising ability of the microorganisms to recover their oxidative ability after an initial inhibitory period. The time lag evidenced before the commencing of recovery and the rate of recovery varied with ion types and concentration.

Another phase of the research is concerned with the development of a controlled testing procedure by which the singular effects as well as the inter-effects of various selected ions on treatment efficiency can be most effectively evaluated.(2)(3) A laboratory-scale pilot plant utilizing the activated sludge process was developed to facilitate the testing procedure. Through the use of a synthetic sewage in a continuous-flow system, operations directly paralleling conventional treatment plant operation were achieved. Upon reaching equilibrium condition, shock dosages of four selected ions, chromium, nickel, copper, and cyanide, were added at pre-planned randomized levels, for a six-hour period.



● **SCHEMATIC** *diagram shows the Laboratory-scale activated sludge unit.*

with three replications of each test for a total of 96 runs. Through the information developed, the singular effect of each ion as well as all possible combinations of inter-effects have been evaluated for their level of significance. At the same time, the resulting retrogression equations for these runs are presently being programmed on the IBM 650 computer to evaluate and to correlate the direct as well as inter-effects of all possible combinations of these four ions. The results of this analysis are not available at this writing.

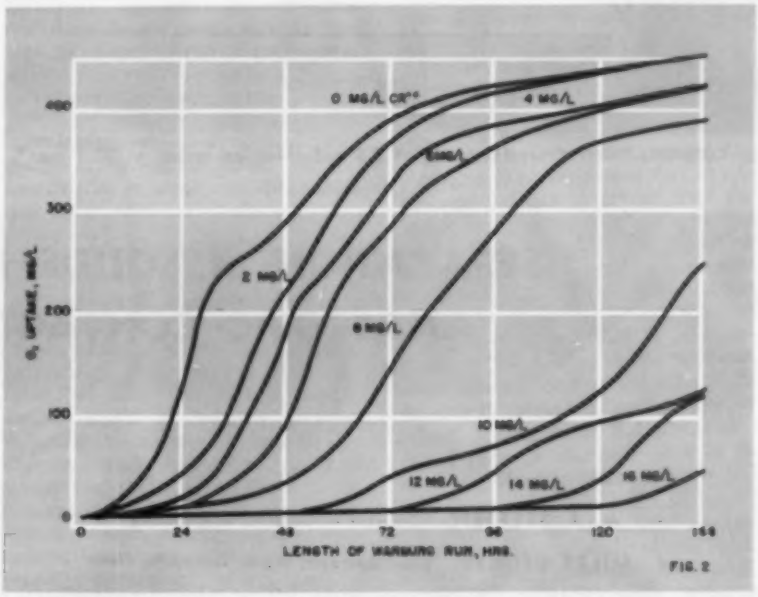
If the information developed from this approach turns out to be as favorable as presently indicated, it is hoped that a large scale testing program can be initiated, directed toward the analysis of a whole host of materials commonly found in various industrial wastes which may have deleterious effects upon the activated sludge process.

Such an approach is also seen as an excellent method by which to evaluate the effect that various loading parameters may have on limiting the toxic effects of various substances of the biological treatment process. However, before proceeding to this phase of the study, it will be necessary to "re-establish" the exact relations that the various loading parameters have upon the removal efficiency of the activated sludge process. This particular

Figure 3 presents the results of one such replicated test indicating several general trends that have been experienced in this research program. For example, there is a significant delay before the full effect of the toxic substances is realized. In this specific case which is typical, the maximal suppression of treatment takes place after 12 hours. Also, the process, and therefore the micro-organisms, normally are fully recovered within a 48-hour period.

It should be realized, however, that any specific conclusions regarding the toxic effect of chromium and nickel cannot be based upon these test curves alone. All the tests in a given "program" must be analyzed and the specific effects separated before conclusions are possible.

To date, two separate pre-planned programs have been conducted, each involving the use of two ion concentration levels for these four ions



● **GRAPHICAL** *results of cumulative oxygen uptake by sewage microorganisms in the presence of various concentrations of hexavalent chromium. (From reference 1.)*

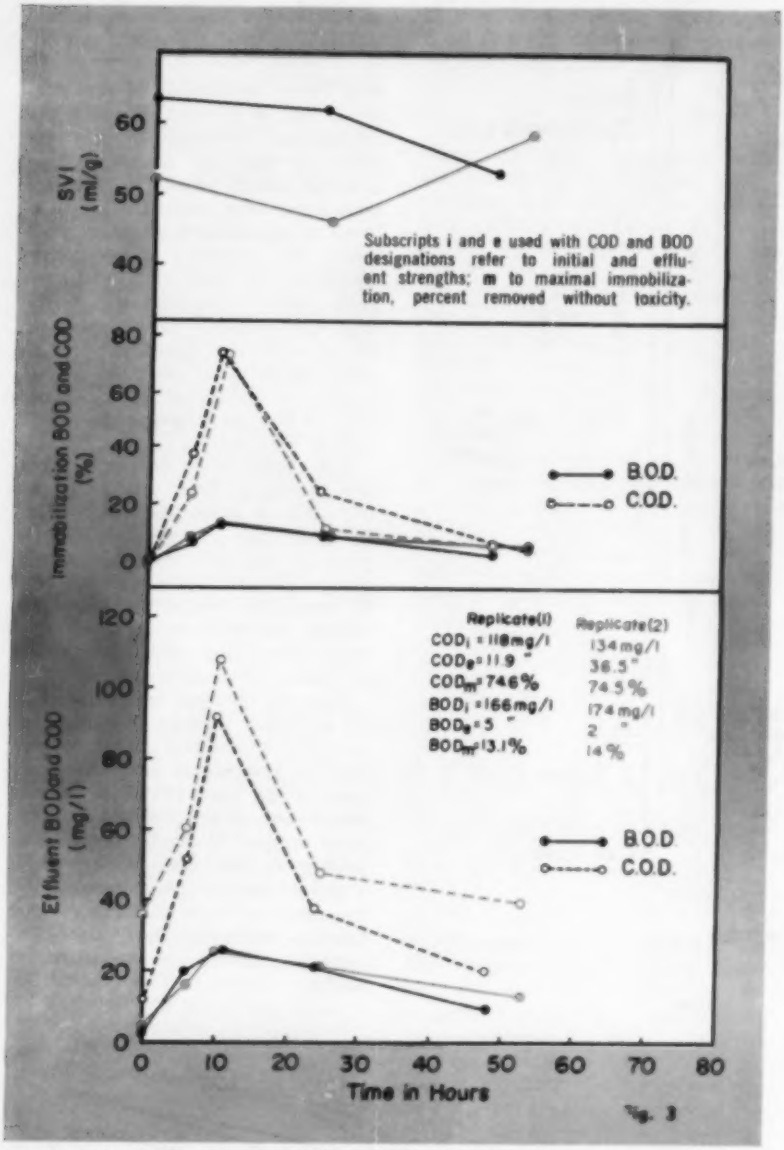


Fig. 3

● COMBINATION of cyanide-nickel at 7.5 and chromium-copper at 22.5 mg/1.

phase of the work has only recently been initiated.

A third phase of this work involves the possible use of sequestering and/or chelating agents as a means of immobilizing various ions which have been proven to have a detrimental effect to the various biological stabilization processes. This work has only recently been initiated, and presently the major effort is being directed toward the development of a control laboratory process through the use of "pure" cultures to make such an evaluation possible.

The new $180,000 expansion of the Water Resources Center made possible by matched funds from the National Institutes of Health and the State of Ohio will be completed this spring. The new bacteriological and chemical laboratory facilities and additional space for operation and process laboratories will provide ample room for initiation of basic studies concerning the various effects of operational variables on minimizing the toxicity of specific ions. Plans are now underway to investigate the effects of suspended solids, BOD loading and aeration rate, on toxicity of the activated sludge effluent, and also to begin a study of effects on digestion.

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SEPARATION of SOLIDS in the ANAEROBIC CONTACT PROCESS

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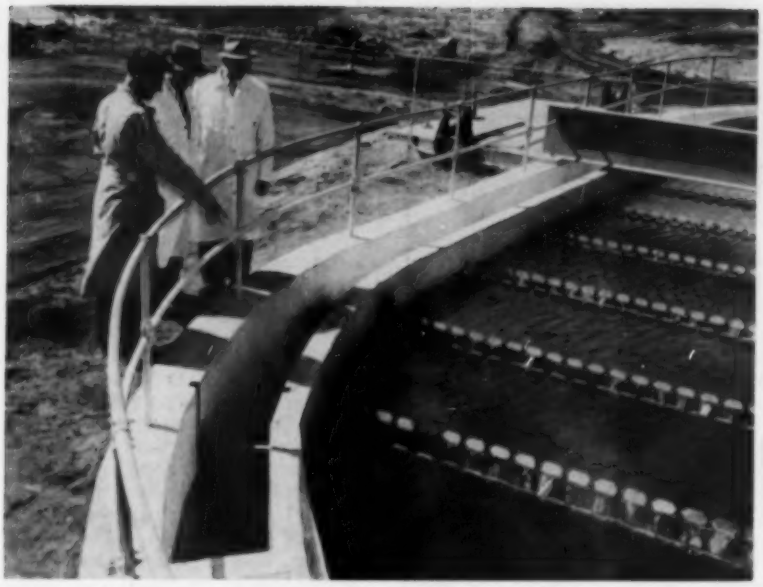
THE FIRST full scale modified anaerobic waste treatment plant for meat packing plant wastes was placed in operation in December, 1956, at Albert Lea, Minnesota. (1) (2) (3) Stepping up from pilot scale to full scale was accomplished by building the plant in three stages—half the anaerobic treatment in the first stage, most of the remainder



● SLUDGE separator, showing troughs discharging to peripheral effluent channel.

of the anaerobic system in the second stage, and completion of the plant, along with oxidation ponds for polishing the effluent, in the final third stage.

Daily BOD analyses on the anaerobic system yield monthly averages of 95 to 97 percent removal. The oxidation ponds, which provide two days detention, remove 50 to 70 percent of the residual BOD in the anaerobic effluent, yielding a final effluent well below the 30 mg/L maximum established by the Minnesota Water Pollution Control Commission.

The anaerobic contact process bears many similiarities to the activated sludge process. The treatment process is largely one of contact since it can take place in a matter of minutes. The sludge must then be separated from the treated liquid and returned to the digesters to serve as seed for incoming wastes. In practice, the treatment plant at Albert Lea provides 12 to 13 hours detention in the digesters based on raw feed and three to four hours based on total flow. A measure of the rate of digestion can be obtained from the sludge age (total pounds of volatile solids in the system divided by pounds added daily in the raw waste), which ranges from 4.5 to 7 days.

The solids in the mixed liquor (suspended solids concentration 9,000 to 14,000 mg/L) are digesting actively as they leave the digester. Separation of the solids was one of the principal research problems encountered in the pilot stage. (4) (5) To permit separation of the solids from the mixed liquor by gravity, a 20 in. vacuum is drawn on the entire effluent from the digesters to remove residual gases. The degasified liquor is then discharged into a sedimentation tank (separator) with a detention time of about 1.4 hours based on total flow including return sludge, and a surface settling rate of about 300 gallons/sq ft./day based on raw flow only. The sludge return rate is about three volumes sludge to one volume plant influent with a 4 to 5-ft. sludge blanket in 9 ft. of liquid depth. The sludge is still very flocculent at this stage and must be removed with suction type rather than scraper type sludge removal mechanism.

Although vacuum degasification was successful in removing solids from the mixed liquor, several other sludge removal methods offered possibilities of improved efficiencies and lower cost.

Alternative Sludge Removal Methods

1. Vacuum degasification with series operation of the separators rather than parallel. The primary objective of this test was to determine whether the return sludge volume could be reduced, thereby reducing the volumetric load in the digesters and degasifiers. A high sludge recycle ratio results in a low concentration of sludge solids in the return sludge. Under normal operating conditions, with the mixed liquor averaging 10,000 mg/L suspended solids, the return sludge will run from 14,000 to 16,000 mg/L.

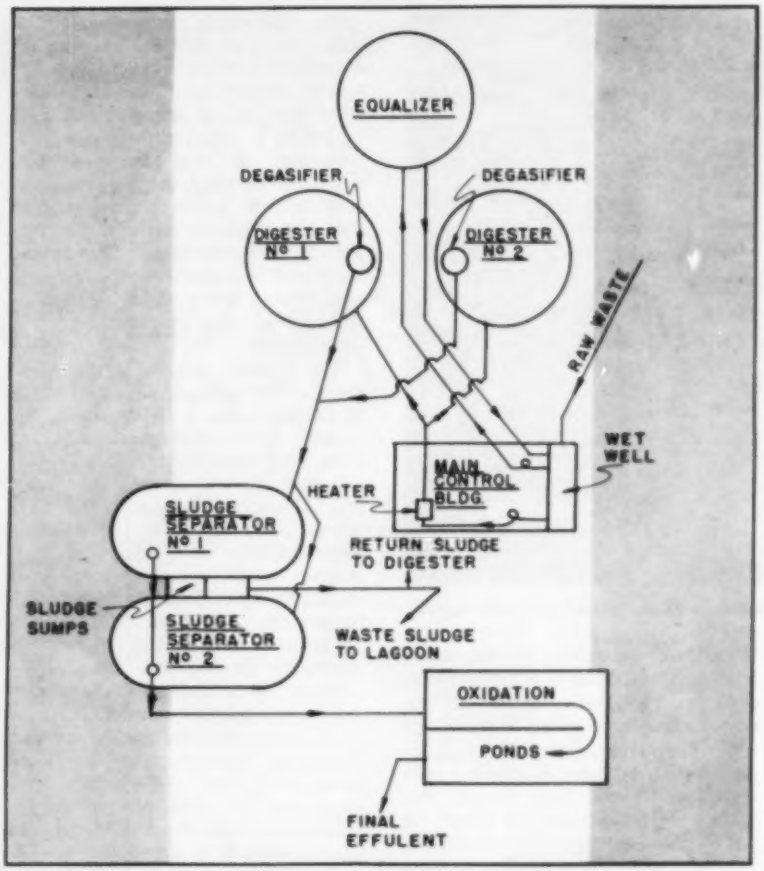
For this study, rectangular pilot scale separators were equipped with automatic suction type sludge removal equipment. The separators were first run in parallel and then in series to determine relative efficiencies. It was believed that hindered settling in the environment of high solids concentration in the mixed liquor reduced the efficiency of the separator. The second separator in a series would logically deal with a lower solids concentration, so an improved effluent was anticipated.

The capacity of each pilot separator was 690 gallons, with 31.7 sq. ft. of surface area. At flow rates comparable to the full scale plant, the pilot scale separators in parallel discharged return sludge at 16,000 mg/L suspended solids, while in series, Separator No. 1 discharged return sludge at 14,600 mg/L suspended solids and Separator No. 2 at 12,000 mg/L. Total detention time in the two separators in series was 75 minutes and in the single stage operation 69 minutes.

These tests showed no improvement in sludge concentration in series operation, as against parallel operation. Indications are that the more flocculent sludge that went over the weir in Separator No. 1 was retained in the system so long that it started to digest again, with resulting gas generation and poor return sludge concentration. There was no appreciable difference between parallel and series operation in overall BOD and suspended solids removals. From this information it was concluded that parallel operation of the separators appears to be more suitable.

2. Degasification by aeration. Borrowing a page from water treatment practices, various means were used in pilot and full scale to aerate the mixed liquor to purge the methane. It is recognized that in this process the gas is driven into the atmosphere and accordingly is not available for heating the incoming raw waste. However, the process is simple, is easily adjusted to variations in flow and character of the mixed liquor, and is less expensive. Pilot studies on a drum scale showed that about 0.1 cu. ft. of air is required per gallon of mixed liquor, with the air introduced through diffusers at 8 to 10 minutes detention in the aerator.

It was feared that aeration might kill some of the anaerobic organisms. However, a study of the flora showed that, whereas the total counts of anaerobes were reduced in the aeration process, they were



● **FLOW DIAGRAM for modified anaerobic treatment plant for packing plant wastes.**

built up again in the sludge separation tank and counts in the return sludge were comparable to counts taken without aeration. Thus aeration may provide an additional benefit in inhibiting gas development in the separator by reducing the count of anaerobes, without affecting the quality of the return sludge.

Based upon laboratory and pilot scale studies an aeration system was installed in the full scale separator, using heavy nylon cloth tubes as air dispersing media. Digestion was not affected during this study, but inefficient aeration resulted in scum formation, with loss of sludge over the effluent weirs and reduced treatment efficiency.

The laboratory and pilot scale work indicated that aeration will successfully remove the methane and excess carbon dioxide gases. However, no improvement in sludge concentration is indicated. Practical considerations, such as additional power requirements for aeration, safety hazards in blowing methane into the atmosphere, possible odor problems and the loss of the methane as a source of additional heat, all contributed to the conclusion that aeration was not practical for our purposes. It was also noted that vacuum degasification yields a superior effluent on the basis of BOD and suspended solids concentration.

3. Flotation. To determine the effectiveness of floating the sludge by pressurized air flotation, tests were run using a self-contained pilot flotation unit furnished by Chain Belt Company. This tank had an effective volume of 420 gallons and an effective surface area of 22.5 sq. ft.

Tests showed that the return sludge volume can be reduced to about 50 per cent of the flow of treated waste, at a surface rate of 1,080 gallons/sq.ft./day. In these tests the suspended solids in the effluent ranged between 200 and 220 mg/L at or below solids loadings of 88 pounds per sq. ft. of tank surface per day. Beyond this point the quality of the effluent deteriorated sharply. This level of treatment would be quite satisfactory for preliminary treatment of packing plant wastes by the anaerobic contact process, where the effluent would be discharged to a conventional municipal sewage treatment plant; but we aim to achieve as complete treatment as possible in the anaerobic phase to reduce the cost of the final aerobic phase. The flotation unit would be slightly larger than one of the two separators needed for sludge separation by vacuum degasification and further clarification of the anaerobic effluent would be necessary to equal the results from vacuum degasification, so this method was discarded.

It is interesting to note that this flotation unit yielded a consistent effluent to a very definite break point in solids loading (88 lbs./sq.ft./day). The air required (0.0166 cu. ft./gallon) is only ⅛ of the air required in the aeration process and the return sludge is concentrated to about 1/6 of the return sludge volume of the vacuum degasification process. This reduction in volume of return sludge increases the sludge concentration in the digesters and should permit greater BOD loadings. This potential advantage justifies further study of this method of sludge separation, especially for pretreatment plants.

From these studies it was concluded that vacuum degasification is the most economical and practical method of producing gravity separation of the anaerobic solids in the mixed liquor in the anaerobic contact process in Albert Lea, Minnesota. However, information obtained indicates that direct aeration and air flotation present possibilities in achieving this same end under less stringent effluent quality requirements.

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FACTORS INHIBITORY TO SLUDGE DIGESTION

Metcalf and Eddy

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THE CONSULTING engineering firm of Metcalf & Eddy has maintained a laboratory to conduct routine chemical and biological analyses on water, sewage and industrial wastes for over 40 years. In addition, many applied research studies have been conducted to obtain the information needed to advise clients. Within recent years, full time, directed basic research investigations have been undertaken. One of these concerns the isolation and identification of agents which inhibit methane formation during the anaerobic digestion of sewage sludge.

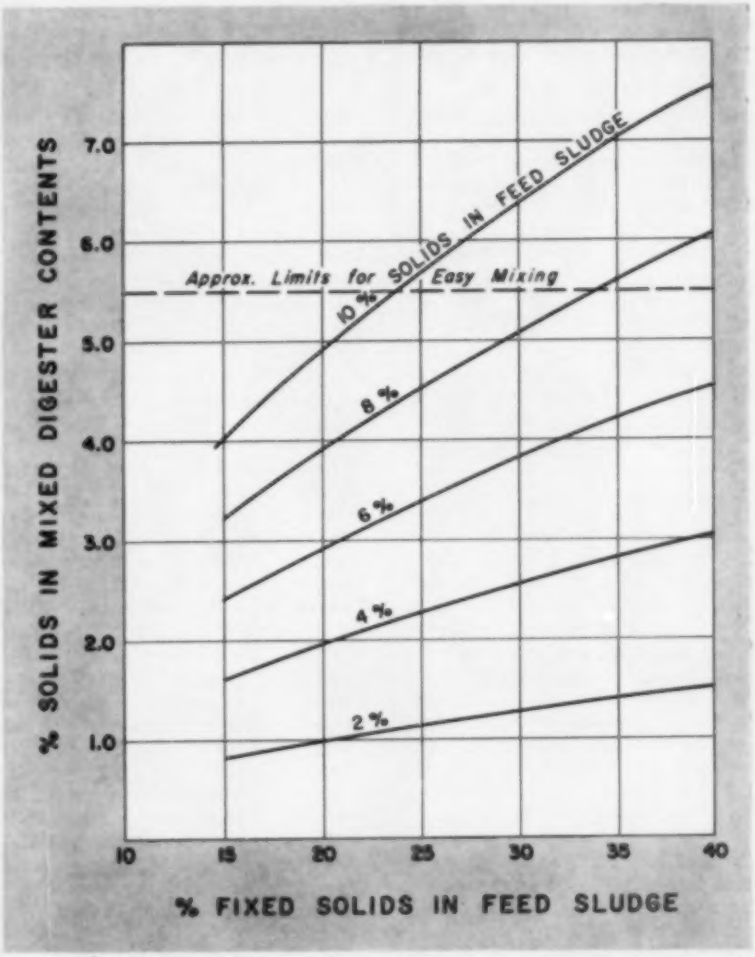
Significance of Project

The use of digestion units of the high-rate type in original designs for sewage treatment plants has not become an accepted practice. The primary users of the process are those municipalities who by virtue of the increased solids loadings received at their plants have been forced to make the most efficient use of the facilities available. Although considerable savings can be realized in capital investment for sludge handling facilities, the unknowns associated with the various schemes for accelerated sludge digestion have limited their use and acceptance.

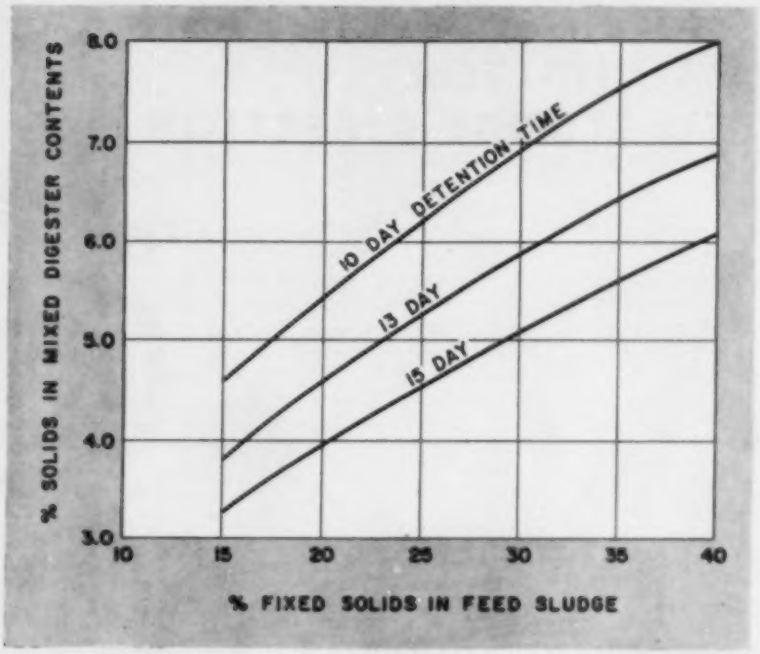
These unknowns are related to the causes for distress and failure of the process. Failures have been experienced at high and low pH levels and at various concentrations of volatile acids, alkalinity, and ammonia nitrogen. Some new factors have disrupted parameters established for the control of conventional digestion processes; making the high-rate process unpredictable at times.

The general concept of anerobic digestion involves the breakdown of raw material to organic acids by the "acid formers" and the further breakdown of these acids to methane and carbon dioxide by a second group of microorganisms, the "methane formers." The first group can operate in a wide range of environmental conditions but the latter is susceptible to even minor changes. Acid formation in properly buffered solutions causes little effect on pH and individual digestion processes operate satisfactorily at various residual volatile acids concentrations. However, a serious inactivation of the methane formers always results in an increased accumulation of volatile acids which further compounds the inactivation by lowering the pH until failure of the digestion process results.

As yet there appears to be no known way to apply brakes to the activity of the acid formers so that the lagging methane formers can catch up. If raw material is constantly supplied, the imbalance becomes more and more critical. The problem is to determine what factors are responsible for the inactivation of methane organisms. These factors may include one or more of



● **FIGURE 1. Relationship between solids content of high-rate digester mixed liquor to fixed solids in feed sludge. The theoretical detention time is 15 days.**



● **FIGURE 2. Solids content of the high-rate digester is dependent on the fixed solids in the feed and the detention time, as illustrated by family of curves above.**

the following: 1) The destruction or impairment of structural cell organization; 2) an interference with the energy-yielding metabolism of the cell; 3) an interference with biosynthesis or growth of the cell; and 4) mechanical injury.(1)

The objectives of the current research are directed toward isolating and identifying the bactericidal or bacteriostatic agents responsible for the inhibitory effect on the methane formers. This knowledge would define the limits for the process and possibly suggest some remedial measures to overcome the adverse effects.

Experimental Approach

Four laboratory-scale high-rate digestion units are being operated on a once daily feeding schedule. These units are of six-liter capacity, each respectively receiving raw sludge of 4, 6, 8 and 10 percent solids on a displacement basis. The units are mixed by gas recirculation for fifteen minutes of every hour. Gas lines are equipped with condensation traps and gas production is measured by a wet test meter. The digesters are housed within a hut where temperature is maintained at 86° F. The entire arrangement is a duplication of the facilities used by Sawyer, Schmidt, Roy, and others at M. I. T.(2)

In addition to the four 6-liter digesters there are four companion 1-liter units containing 0.6 liter of digesting sludge. These are maintained by feeding supernatant liquor from the large digesters with acetic acid added for food. The gas production from these units is measured by a gas collection cylinder by displacement of confining fluid. These units are similar to those used by Buswell.(3)

The necessary equipment is available for conducting determinations of volatile acids, alkalinity, ammonia-nitrogen, pH, etc. in accordance with *Standard Methods*.(4) In addition to a spectrophotometer, the other major item of equipment is the Beckman, Spinco Division, continuous paper electrophoresis apparatus.

A combination primary-activated sludge is obtained from the Leominster Sewage Treatment Plant, Leominster, Massachusetts. This sludge is thickened to 10 percent solids by flotation and is stored in a refrigerator at 7° C until used. The time for floating sludges has varied from 2 to 3 days. The stock sludge is diluted with Boston tap water to obtain the respective 4, 6, and 8 percent solids feedings. The volatile solids content of the feed sludges has been as high as 88 percent but averages around 84 percent. Only in a few instances have they been below 80 percent volatile solids and during such times some interesting and important observations have been made.

It was initially intended to operate the 6-liter units on a theoretical 15-day detention period with a probable failure occurring in the unit fed 10 percent sludge. All units were started by feeding a 4 percent sludge. The concentration of sludge fed was gradually increased to certain of the units until they were operating with feed sludges of 4, 6, 8 and 10 percent solids. This approach enabled comparisons to be made on the behavior of the units under various solids loadings and provided sufficient time to obtain information on the extent of biological degradation occurring in each unit. In case of failure, the mixed liquor from the failed or stuck digester was to be clarified and subjected to electrophoretic separation. The fractions derived were to be fed to the small 1-liter digesters to determine which fractions caused detrimental effects. Those fractions showing inhibitory effects could then be submitted to more complete analysis. The difficulty encountered, however, was in removing suspended or colloidal matter from the sample to be fractionated. These materials clogged the paper and prevented satisfactory separation. It has, therefore, been necessary to develop additional methods for clarifying mixed liquor samples prior to subjecting them to separation.

Results and Discussion

To realize maximum efficiency of the anaerobic biological process, the entire capacity of the unit must be used to advantage. The dewatering or thickening of feed sludge removes a known amount of water which otherwise would require space within the unit. However, the degree to which feed sludges should be thickened is limited to three major considerations: 1) Ability to pump thickened sludge; 2) ability to distribute or mix feed sludges into the digestion unit; and 3) ability to maintain proper mixing within the digestion unit.

In handling concentrated raw sludges in the range of 8 to 10 percent total solids, pipe friction losses alone may be on the order of 6 to 8 times those encountered when pumping water. 4) It appears uneconomical, therefore, to thicken sludges beyond 10 percent.

Concentrated raw sludge of 8 to 10 percent total solids is viscous and has a tendency to jell. The viscosity increases in sludges having higher volatile solids content. It appears impractical to thicken raw sludges having volatile solids of more than 65 percent to more than

8 percent solids because of the difficulty in mixing this viscous batter into the contents of the digester. Mixing becomes difficult when the mixed liquor total solids concentration approaches 6 per cent; and since high fixed solids feed supports equally high mixed liquor total solids concentrations, the degree to which low volatile raw sludges should be thickened is also limited. These relationships for a theoretical 15-day detention period are shown in Figure 1. (6)

The concentration of fixed solids in the feed sludges places two limitations on the operation of high-rate digestion units. There is a limit to the degree to which *low* fixed solids sludges can be thickened because of the difficulty in distributing them within the digestion unit; and the degree to which *high* fixed solids sludges can be thickened is limited because of the difficulty in maintaining good mixing of the digester contents. Decreased detention time merely compounds the difficulty of maintaining good mixing. Figure 2 illustrates the increased total solids concentrations in mixed liquor resulting from decreased detention times for a unit receiving feed sludges of 8 percent solids.

The foregoing discussion places physical and economic limitations on processing sewage sludge for disposal by high-rate digestion. In addition to the mechanical inhibitory effects, there still remains the question of what bactericidal agent is responsible for the actual inhibition of the methane formers and how this inhibition occurs. In all experiences of distress and failure during this study, gas formation has been retarded. This phenomenon is apparent when mixed liquor total solids concentrations approach 6 percent, but is particularly pointed out through observations of gas production by the small companion 1-liter digestion units.

These 1-liter units are receiving centrifuged supernatant liquor from the respective 6-liter laboratory units augmented with 1 ml. of glacial acetic acid (1750 mg/L as HAc per day) on a theoretical ten-day detention period. The daily gas yield from each of the four 1-liter units is essentially the same. The efficient units release the major portion of gas within the first 12 hours after feeding. The units which border on distress release the major portion of gas yields during the second 12 hours after feeding. As long as the total gas yield is released prior to the next feeding, the inhibited units continue to operate satisfactorily. But when further retardation occurs and expected gas yields decline, then critical distress resulting in failure can be expected.

The gas production in a unit in distress does not affect the pH until the volatile acids residuals accumulate to concentrations of 1,000 mg/L as HAc or more, depending on the buffering capacity of the unit. In critically distressed units, gas yields may be experienced for many days before any change occurs in the pH.

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VOLATILE ACID FORMATION DURING SLUDGE DIGESTION

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ANAEROBIC digestion is used in most sewage treatment plants for stabilizing and reducing the volume of solids requiring disposal. While the anaerobic digestion process has been widely adopted, little is known about the actual mechanics of the process or about the factors affecting its efficiency.

In general, digestion is thought to take place in two phases. In the first phase complex materials such as carbohydrates, proteins, and lipids are decomposed into simpler materials most of which are volatile acids. The further decomposition of the simpler materials during the second phase results in the formation of gaseous products consisting mainly of carbon dioxide and methane. Buswell and co-workers (1) were among the first to emphasize the importance of the volatile acids produced during the digestion process. In their investigations, and in many subsequent investigations, it has been shown that volatile acids accumulations in excess of about 2000 mg/L (as acetic acid) interfere with methane production in the second phase of digestion. The production of volatile acids is undoubtedly associated with the organic sewage solids loading of the digestion process, but no fixed relationship between the two factors has ever been determined.

In the past many sewage treatment plants have used routine observations such as changes in pH and in gas production for determining the condition of the digestion process. By the time a decrease in gas production or pH has been observed, interference with the methane production phase of digestion has already started. The routine analysis for volatile acids can also be used for determining the condition of digestion; however, because of the complexity, unreliability and time consuming nature of the presently available steam distillation method of analysis little use has been made of this control procedure.

It was the purpose of these research investigations to attempt to develop a less time-consuming and more reliable procedure for determining total volatile acids concentrations, and to study the factors affecting the volatile acids production resulting from increases in organic solids loadings.

Determination of Volatile Acids

The volatile acids formed in anaerobic digestion include valeric, butyric, propionic, acetic, and formic acids. Several methods for determining individual concentrations of these have recently been developed. The procedure used for separation of the individual volatile acids in these studies was a modification of a chromatographic technique described by Mueller, Buswell, and Larson. (2)

A new method for determining total concentrations was developed in conjunction with these investigations by G. H. Teletzke, formerly of the Purdue University staff. The method is rapid and reliable which makes it readily applicable to routine control of the digestion process. Total volatile acids determination is as follows:

Reagents:

Silicic acid: Mallinckrodt's Silicic Acid No. 2847 "specially prepared for chromatography". The silicic acid is dried at 103°C. until absolutely dry and is then stored in a dessicator.

CB_{10} Solvent: Mix 40 ml. of n-butyl-alcohol with 360 ml. of chloroform and shake with about 80 ml. of 0.5 N-H_2SO_4 in a separatory funnel. After shaking, allow the water layer to separate from the organic layer and drain off the lower (organic) layer through a filter paper into a dry bottle.

Procedure:

1) Centrifuge or vacuum filter about 50 ml. of sludge.

2) Place 10 grams of silicic acid in a Gooch crucible fitted in a filtering flask. Pack the silicic acid by applying suction to the flask.

3) Add a few drops of thymol blue indicator to supernatant from (1). (0.1 percent by weight in ethyl alcohol).

4) Add 10 N H_2SO_4 dropwise until sample is just red to thymol blue.

5) Place 5 ml. of the acidified sample on the silicic acid column. Draw the sample into the column by applying suction to the filtering flask. Release suction as soon as the sample is completely drawn into the silicic acid.

6) Apply suction to the Gooch crucible and draw 100 ml. of CB_{10} through the silicic acid into the filtering flask.

7) Titrate to a phenolphthalein (0.1 percent by weight in ethyl alcohol) end-point the acids in the solvent in the filtering flask. Titrate with approximately 0.015N NaOH in absolute ethyl alcohol. The sample may be mixed during titration by bubbling nitrogen or CO_2-free air through it. CO_2-free air may be obtained by passing compressed air through lime water or Ascarite.

8) Titrate in a similar manner a blank of 100 ml. of CB_{10}.

Calculation:

Total Volatile Acids in mg/L (as acetic) = 12,000 N (a-b)

N = Normality of NaOH is ethyl alcohol.

a = titer of sample in ml.

b = titer of blank in ml.

Table 1—Experimental Results of Thermophilic Digestion At 140° F

Day of Test Period	*Volatile Solids Loading lbs./cu.ft.*	*Gas Production /Day cu.ft.*	*pH*	*Total Volatile Acids (a) mg/L*	*Percent Composition of Individual Volatile Acids*				*Alkalinity (b) mg/L*	*Calculated "Volatile Acid-Salts" Alkalinity (b) mg/L*
					Valeric & Butyric	*Propionic*	*Acetic*	*Formic*		
3	0.115	0.094	7.05	2300	17.4	67.4	6.7	8.5	2410	1920
11	0.115	0.092	7.05	2250	18.8	66.4	6.3	8.5	2450	1870
17	0.115	0.090	7.05	2500	21.1	64.9	3.5	11.5	2530	2080
24	0.126	0.090	7.00	2530	22.2	66.0	3.7	8.1	2780	2110
27	0.126	0.086	7.00	2940	25.9	63.6	1.4	9.0	2800	2450
33	0.126	0.080	6.90	2980	26.1	62.2	3.6	8.1	2780	2480
42	0.139	0.086	7.00	3050	26.8	63.7	2.5	7.0	2670	2540
48	0.139	0.089	7.10	2930	19.3	68.7	2.5	9.5	2850	2440
60	0.162	0.143	7.05	2740	19.2	73.3	1.1	6.4	2780	2280
67	0.190	0.191	7.15	2780	18.1	76.5	1.1	4.2	2730	2320
70	0.190	0.201	7.15	2850	18.6	74.4	1.7	5.2	3200	2370
73	0.190	0.207	7.15	2660	15.5	79.0	2.7	3.0	3140	2220
78	0.210	0.172	7.15	2980	19.3	73.5	2.4	4.9	3470	2480
81	0.210	0.127	7.15	3020	20.2	72.0	3.6	4.0	3620	2520
84	0.210	0.116	7.05	3290	24.0	63.5	5.8	6.5	3700	2740
87	0.210	0.090	7.00	4250	22.0	51.5	20.7	5.7	3660	3540
90	0.210	0.064	6.80	4480	24.2	41.5	29.8	4.5	3570	3730
102	0.173	0.029	6.60	4770	24.7	35.4	35.4	4.5	3190	3980
117	0.136	0.014	6.50	5030	21.6	24.2	48.4	5.7	2840	4190
126	0.202	0.015	6.40	5530	18.5	21.8	52.1	7.6	2830	4600
135	0.234	0.019	6.20	5980	19.7	21.6	52.1	6.3	3410	4990
141	0.234	0.017	6.00	7140	21.3	22.4	50.0	6.2	3640	5940
157(c)	0.133	0.055	6.00	6250	15.3	15.3	66.9	2.5	3570	5210
163	0.180	0.112	6.65	5610	22.1	16.5	58.8	2.7	3930	4670
166	0.180	0.118	7.05	4050	26.5	29.5	38.4	5.6	3810	3370
169	0.180	0.101	7.15	3770	35.0	38.9	19.0	7.2	3970	3140
172	0.180	0.094	7.20	3250	32.2	44.8	13.1	9.9	3920	2710

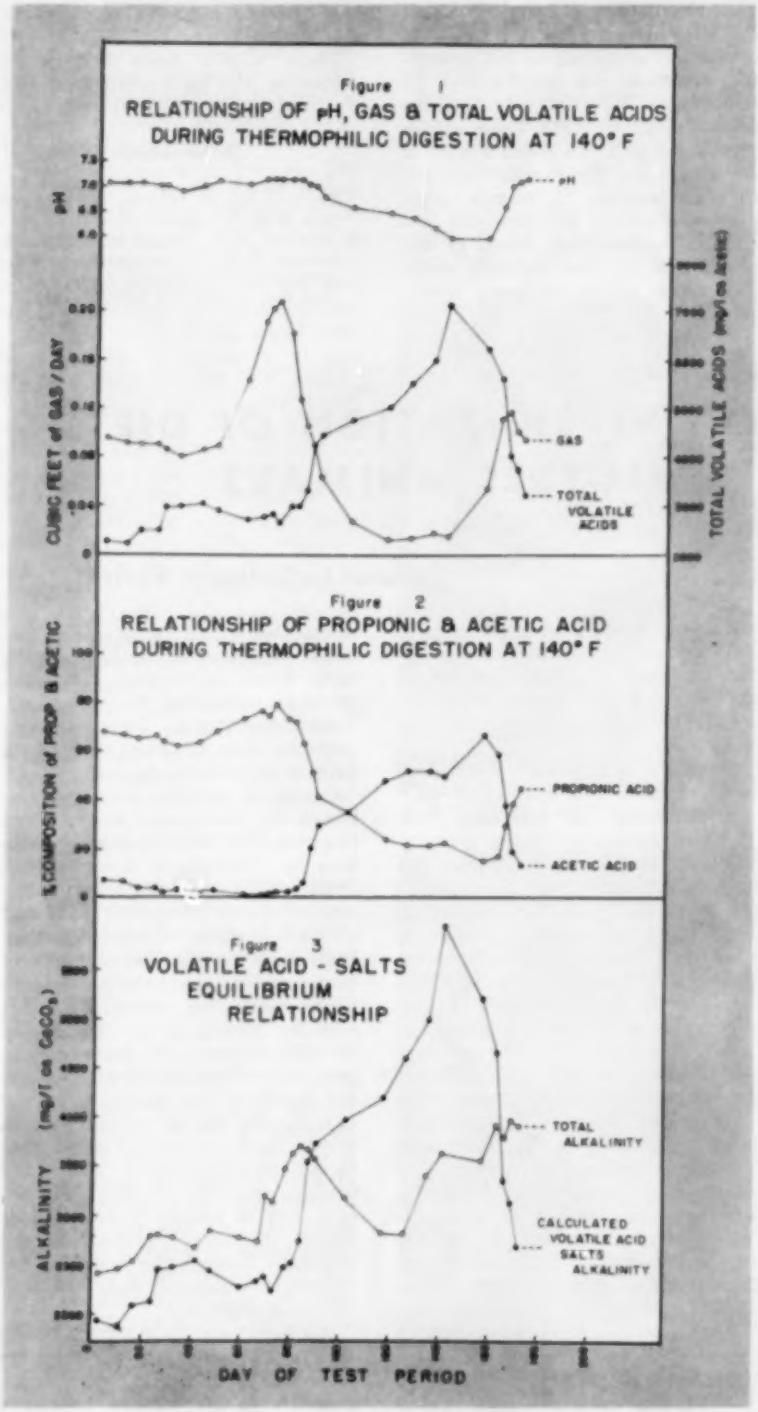
(a) As Acetic Acid (b) As $CaCO_3$ (c) Lime Added

Digestion Studies On Domestic Sewage Sludge

The primary purposes of the digestion studies was to observe the effect of changes in organic solids loadings on the formation of total and individual volatile acids, and to determine whether any changes occurred in the individual acids concentrations prior to the start of interference with gas production.

Preliminary studies indicated that digestion at volatile solids loadings of about 0.1 lb. per cu. ft. of digester capacity gave rise to total volatile acid concentrations in excess of 2000 mg/L (as acetic acid) in the thermophilic temperature range. At the same loading rate the total volatile acids concentration in the mesophilic temperature range was only about 200 mg/L (as acetic acid). Since the procedure for determining the individual volatile acids composition is more reliable when the total volatile acids concentration is above 200 mg/L, the initial digestion studies were performed in the thermophilic temperature range at 140° F.

The results of typical daily analyses made on the sludge from the digestion unit are shown in Table I.



● **ANALYSIS of trends during thermophilic digestion show the important relationship of acetic and propionic acid concentrations to pH and methane formation.**

Discussion of Data

Analysis of Figures 1 and 2 indicated that digestion proceeded normally until the 73rd day of the test period at which time the total volatile acids concentration increased as gas production decreased. These changes were followed by a decrease in pH value. Coincident with the increase in total volatile acids there was a progressive change in the relative proportion of the individual volatile acids, notably propionic and acetic acids. Whereas propionic acid predominated during normal digestion it began to lose its predominance when the total volatile acids started increasing and gas production decreasing. This trend continued until acetic acid had become the predominant acid at which time the pH and gas production of the digestion unit had reached minimal values, and the total volatile acids reached a maximum. A lowering of the volatile solids loading and the addition of a quantity of lime eventually resulted in a return to normal digestion at which time the propionic acid again became predominant.

Although all of the individual volatile acids undoubtedly play an important role in the digestion process, the main mechanism of volatile acids production resulting in methane formation seems to involve propionic and acetic acids. Analysis of the possible reasons for predominance of either propionic or acetic acid during the digestion process would seem to suggest that during the time of decrease in gas production the acetic acid is no longer being decomposed to methane and carbon dioxide as rapidly as it is being formed. The decrease in propionic acid may be the result of a disruption in the mechanism producing propionic acid and also to

the production of acetic from propionic acid. Experiments are presently underway which may clarify this hypothesis.

Efforts are also being made to explain the behavior of the digestion process in terms of a "volatile acid-salts" equilibrium. It seems reasonable that the volatile acids formed during normal digestion exist as salts of the available cations present (Ca^{++}, Mg^{++}, Na^{+}, NH_3^{+} etc.), introduced either from mineral salts or from biological decomposition as in the case of ammonia. These salts are titratable as alkalinity. Alkalinity is expressed as acid neutralizing power, therefore salts of the total volatile acids which react with sulfuric acid actually appear as part of the alkalinity. These relationships may be exemplified by the following equations:

$$CaCO_3 + H_2SO_4 = CaSO_4 + H_2CO_3$$

$$CaCO_3 + 2\,CH_3COOH = Ca(OOC\,CH_3)_2 + H_2CO_3$$

$$Ca(OOC\,CH_3)_2 + H_2SO_4 = 2\,CH_3\,COOH + CaSO_4$$

The calculated quantity of alkalinity contributed by the "volatile acid-salts" according to the preceding equations can be obtained by multiplying the total volatile acids concentration by 0.833. These values are shown in Table I and Figure 3. An analysis of these data indicated that an increase in volatile acids over and above the available associable cations may result in the production of free volatile acids, destruction of the buffering action of the sludge, and resultant rapid decrease in gas production and pH. The shaded area in Figure 3 shows the period during which free volatile acids were probably present. The additions of lime toward the latter part of the studies and the subsequent recovery of the digestion process seem to substantiate this supposition.

These studies have been supported in part by a grant from the National Institutes of Health.

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IRRADIATION STERILIZATION OF DIETS FOR GERM-FREE ANIMALS

National Institutes of Health

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SOME of the novel problems raised by the Public Health Service's medical research program conducted at the National Institutes of Health in Bethesda, Maryland, are leading sanitary engineers stationed there into new fields.

There are over 6,500 employees on the 300 acres comprising the Institutes, and housing them presents all the sanitation complexities of a small city. The 500 patients cared for in the Institutes' Clinical Center are providing opportunities to the Institutes' sanitary engineers to work closely with clinical personnel on a number of details of hospital design and operation and their relationship to hospital infections.

A major area of sanitation activity has been the design of facilities for housing and caring for more than one million laboratory animals. Infections within animal colonies can be costly and such measures as the installation of automatic cage washing equipment have been taken to reduce these risks. One of the most unusual assignments for the sanitary engineers has been in the field of designing and operating equipment for studies of germfree animals.

Contrary to previously held concepts, animals can live when they are externally and internally free of microorganisms. (There is some question yet whether viruses are completely absent from them.) Medical research is now actively using these "germfree" laboratory animals to study such problems as bacteria-protozoa interrelationships in amebic dysentery, and the role of microorganisms in dental diseases. It is only a matter of time before uses for germfree animals will be found for sanitary engineering research.

A prime requisite in germfree animal studies is to obtain animals that resemble their conventional or normal "contaminated" counterparts as closely as possible. One important test of the germfree animal's conventionality is its ability to reproduce. Two groups (University of Notre Dame, and University of Lund, Sweden) have succeeded in breeding several generations of germfree rats.(1),(2) Results have not been as successful with germfree guinea pigs; in only three instances, once at the University of Notre Dame, and twice at the National Institutes of Health in 1959, have litters of second generation germfree guinea pigs been produced. These departures from conventionality may be due, at least in part, to deficiencies in diet.

Germfree animals are first obtained by Caesarean section, and then must be kept in closed chambers or "tanks" to protect them from contact with the research investigator and from water, food and air-borne routes of contamination. Each tank or chamber consists of four principal elements: a) A large enclosure for the animal, b) a device for sterilizing the air supply to the chamber, c) some means, such as rubber gloves attached to the chamber, for manipulating the animal, and d) an access lock in which food, water and other materials are sterilized and then brought into the chamber. The access lock is usually a double-door steam sterilizer attached to the chamber. Though the design of the chambers varies, all have the four elements described.

All diets must be sterilized before they are brought into the germfree chamber. Sterilization under steam pressure is the method ordinarily used, although the factors of temperature and length of time for

steam sterilization introduce certain undesirable effects; among these are the carmelization of sugars and the depletion of certain essential vitamins in diets. To minimize the deleterious effects of heating food, sterilization through ionizing irradiation has been extensively studied by various investigators.(3) (4) Although it is conceivable that this method of diet sterilization may introduce undesirable effects on the animals, at least it avoids the effect of high temperatures.

This consideration led to the search for a method by which germfree animal diets, particularly those developed for guinea pigs, and other heat-labile materials could be sterilized by ionizing radiation and introduced into any germfree system.

The first stage of the study was to determine, by means of a test organism, the amount of radiation required for uniform sterilization of the diets. The spore-forming organism *B. globigii* was selected as the test organism because it has greater resistance to the lethal effects of radiation than non-spore forming organisms. The radiation source was the electron beam produced by a 3-million electron volt Van de Graaff accelerator. Water suspensions of *B. globigii* in covered petri dishes were irradiated with various doses.

From the data obtained, the following equation predicting the survival of *B. globigii* spores was derived for a medium having a weight of 0.85 gram per square centimeter.

$$N_s = (N_o)(10)^{-15X}$$

where

N_s = Number of *B. globigii* spores surviving irradiation.

N_o = Original number of *B. globigii* spores before irradiation.

X = Radiation dose, millions of rads; (one rad = an absorbed dose of 100 ergs per gram of material).

Calculations from the derived equation show that the expected number of organisms surviving a dose of even one million rads is very low. Since the survival rate of organisms exposed to irradiation follows the exponential decay form, theoretically a 100 percent kill can never be attained. Thus, it is necessary to add a large safety factor to the radiation dose to assure that complete sterilization can be consistently accomplished.

This is particularly true when initial contamination of the food is high and large quantities are involved, or when these factors exist independently. Other reasons for requiring a substantial factor of safety in the radiation dose are the practical difficulties in accurate measurement of the dosage imparted by the beam from the Van de Graaff unit at the high doses used and variations in the thickness of diet materials exposed to irradiation.

Because of these several factors, radiation doses in the range of 2 to 3 million rads were used for sterilizing germfree guinea pig and rat diets.

In addition to establishing the range of the sterilizing radiation dose, various procedures for assuring the sterility of the diet also required development. The beam characteristics of the Van de Graaff generator and the radiation absorption characteristics of the diet are such that the depth of effective beam penetration into the diet is 1.5 cm.

When the packages exposed to the beam were thicker than 1.5 cm., it was observed that the attenuation of the beam was such that the material in the bottom of thick packages would not be sterilized. To control the thickness of each diet package to assure complete beam penetration, all packages are placed on metal trays with sides 1 cm. high,

(*Continued on page 188*)

● **GERM-FREE** animal rearing chamber in use at the National Institutes of Health.

● **EQUIPMENT** used for irradiation sterilization of diet for germ-free animals. Packages of food in trays travel on the table and pass under cone of a 3 mev Van de Graaff accelerator. A TV camera is used for remote monitoring of the process.

● FIBER DRUMS which had contained parathion were deemed a potential health hazard to equipment operators at landfill.

● BULLDOZER operator with respirator and exposure patches in place. Study indicated that hazard to operator was minimal.

STUDY of HAZARDS *in Disposing of Insecticide Containers at a City Landfill*

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MANY municipalities must face the problem of disposing of containers and toxic waste materials resulting from the manufacture, formulation, and use of pesticides. The study outlined here was instituted to solve such a problem in the City of Phoenix, Arizona.

Numerous newspaper accounts of poisonings affecting individuals occupationally exposed to toxic insecticides have engendered an acute public awareness of the hazards associated with insecticide poisoning in the Phoenix, Arizona, area. It was, therefore, not surprising when operators at the City landfill became indisposed that they suspected loads of used bags and drugs deposited at the landfill by insecticide formulating firms might be related to their illnesses. Consequently, the Superintendent of the City Streets Department, responsible for the operation of the landfill, prohibited the dumping of such materials. This action resulted in the accumulation at the formulating plants of empty multiwalled paper bags and drums to the extent that the City Fire Marshal designated them fire hazards. The Toxicology Unit of the Phoenix Feld Station, Technology Branch, Communicable Disease Center, was requested by the Fire Marshal's office to provide formulating plant personnel with technical advice on the safe disposal of the accumulated material.

A meeting was called to develop a workable solution to the problem. There were present representatives of the Fire Department, the Streets Department, insecticide formulating firms, and the Communicable Disease Center. Discussion revealed that approximately 85 percent of the waste containers from formulating plants consisted of multiwalled paper bags. These had contained pyrophyllite, diatomaceous earth, other inert fillers, and chlorinated hydrocarbon insecticides which are relatively innocuous and would not, under existing disposal practices, constitute a hazard to the disposal site operators. It was therefore decided that privileges for disposing of such materials would be reinstated. There was, however, a potential hazard to bulldozer operators in the disposal of fiber and metal drums which had contained concentrates of toxic organic phosphorous insecticides such as Phosdrin, Thimet, and parathion. These fiber and metal drums in good condition are eagerly seized upon by scavengers at most disposal sites. The presence of usable containers would constitute a distinct health hazard to these individuals.

Because of the embargo on disposal at the landfill, fiber drums and metal containers had accumulated to approximately 40 times the number usually on hand for periodic disposal. The Toxicology Unit thereupon suggested the disposal of containers contaminated with toxic organic phosphates on two designated days under controlled conditions. A careful exposure study would be made on the bulldozer operator compacting and burying the insecticide containers.

In order to reduce the possible hazard, all fiber drums designated for disposal at the landfill were crushed at the insecticide plants to eliminate the clouds of dust which might arise if the landfill bulldozer did the crushing. Metal containers were washed three times with water and rendered unserviceable by multiple punctures before being discarded. The crushed fiber drums and punctured cans were divided into two lots; each lot was mixed with a load of paper refuse and taken to the landfill at designated times. Plant floor sweepings collected after formulating and bagging operations were not sent to the

landfill but were disposed of on the premises of the plant.

Observations on the bulldozer operator started before the first load was dumped. Blood was taken for the determination of baseline cholinesterase, an enzyme inhibited by organic phosphorous compounds. The operator was instructed to save all urine as individual voids during the study for the measurement of paranitrophenol, a metabolite of parathion.

An hour before delivery of the contaminated loads, a fresh filter was inserted into the bulldozer operator's respirator. He was given an alcoholic handwash, and gauze pads were attached to his shoulders, back, and right and left breast. After the loads had been compacted and covered according to the usual landfill procedure, the gauze patches were removed and another alcoholic handwash was given. These samples then were analyzed for parathion content.

The results of chemical analyses carried out on blood, urine, alcoholic handwashes, and patches indicated that the operator's exposure to parathion was minimal. Blood taken for the determination of cholinesterase failed to show any inhibition of either plasma or red blood cell cholinesterase activity. The urine collected as individual voids during the course of this study was analyzed, and only three samples contained traces of paranitrophenol. The paranitrophenol found was 50 to 100 times less than that found in such occupationally exposed individuals as crop dusters. Parathion recovered from exposure patches and alcoholic hand washings after the dumping of each experimental load was found in trace amounts which approached the lower limit of sensitivity for the analytical method. This analytical method will detect microgram quantities of parathion.

This study indicates that disposal of containers for organic phosphorus insecticides may be conducted with safety to landfill personnel when precautions mentioned above are observed. As a result of this study, certain regulations governing disposal of these containers were adopted by Phoenix landfill officials.. These regulations require that fiber drums which have contained highly toxic pesticides be crushed, and metal containers be washed and punctured at the formulating plants prior to disposal. Floor sweepings and other spillage of highly toxic insecticides should be disposed of by trained plant personnel and not sent to the public landfill.

SUBSURFACE BEDROCK ALONG HIGHWAY ROUTE MAPPED BY SEISMOGRAPH

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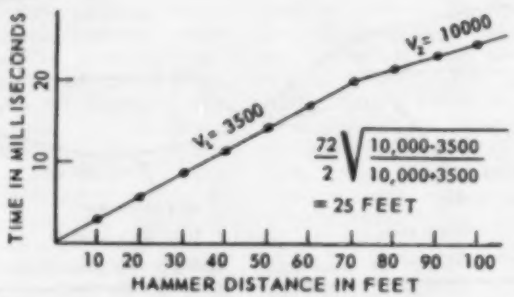
A NEWLY DEVELOPED miniature engineering seismograph was used in 1957 to do preliminary survey work on subsurface materials and conditions for a proposed highway route through the rugged North Shore area around Lake Superior, North of Duluth, Minnesota. Subsequent test borings and actual highway construction demonstrated this seismic analysis to have been accurate within 5 percent.

The firm of Ellerbe and Company was commissioned by the Minne-



The seismic analysis method is based on the fact that sound waves travel through subsurface materials at widely varying velocities, depending upon the material densities or degree of consolidation. For example, velocity in the glacial drift encountered on this survey was 1100 ft. per second; for the Lake Superior red clay velocity was 4500 ft. per second; and for bedrock 10,000 ft. per second.

The MD-1 miniature engineering seismograph records the time it takes a sound wave to travel from point of origin to the unit's receiver, a geophone. A sledge hammer blow struck on a metal plate at 50 ft. distance from the seismograph initiates a sound wave; at the same time, a circuit is closed on the hammer handle that sets the seismograph's counter in operation. The first sound wave to reach the geophone is recorded and read directly on the unit's exterior counter lights.

Time readings and distances are then plotted on a graph as shown in the accompanying diagram. Points fall in line for each type of subsurface material. The slope of the line represents the velocity of sound through the particular material encountered. Intersections of the lines represent changes in consolidation.

Depth at which these changes occur is computed by the formula

$$D=\frac{X}{2}\sqrt{\frac{V_2-V_1}{V_2+V_1}}$$

where D is depth, X is the distance along the bottom of the graph from zero to the intersection point of the lines, V_1 is the velocity of the seismic wave in the upper layer and V_2 is the velocity in the next lower layer. A nomograph can be used to eliminate mathematical calculations.

Depending on the materials involved, an 8-lb. sledge generates sufficient energy for exploring to depths in the order of 50 to 75 feet. Sounding to depths of 200 feet or more is possible by supplementing the hammer with small explosive charges.

sota State Highway Dept. to select the route, prepare the grade and design work and supply supporting data for specification writing on a 7½-mile section of U.S. 61 Alternate. The proposed route traversed highly irregular terrain in which the overburden was glacial drift strewn with large boulders. Heavy second growth timber was a barrier to engineering survey work. A previous study of the area by the state geological society showed that bedrock occurred at variable, unpredictable depths. Numerous outcroppings were cited in the report, which raised the question of the depth and extent of the rock strata. This report was visually confirmed during the engineering survey work.

Because of a number of cuts proposed along the route it was necessary to obtain specific subsurface information. However, right-of-way land was not yet purchased so that clearing timber for access roads was not possible. Also, three critical points along the proposed route were totally inaccessible to mobile drilling rigs. Hand auger drilling was tested but abandoned as impractical because of the great number of boulders in the glacial till.

Faced with these problems, the engineering firm engaged the services of the exploration department of Geophysical Specialties Company to survey the area by seismic analysis. This company had designed the MD-1 miniature seismograph for engineering and construction applications and the contract exploration department was a logical outgrowth.

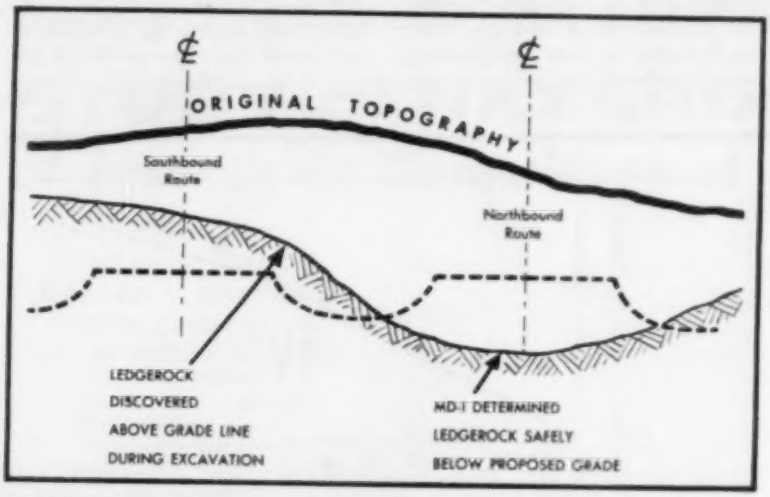
The assignment was to establish the presence or absence of bedrock at specified locations to a depth of 5 ft. below the proposed grade line. The northbound lane was selected for the seismic traverses because its elevation suggested the bedrock would go deeper in the southbound lane. Also requested were rock profiles of two specific bridge site areas.

The seismic exploration was accomplished in two weeks by a two-man crew. Soundings were made every 10 ft. along the centerline through the specified locations and the findings were charted on a profile map. The entire survey was made without any borings.

In the seismic study, several important rock anomalies were located. For example, although outcroppings of rock on the upper side of French River Gorge suggested a possible problem, the portable seismograph indicated that the outcropping dipped sharply and did not exist above the proposed gradeline. Actual excavation work on this section confirmed the seismic analysis. At another point the seismic traverse along the centerline of the northbound lane showed no rock in the cut zone of this section. During actual excavation, rock was encountered in the southbound lane in the cut zone where no seismic traverse was made. This required blasting to remove 5000 yds. of rock.

In summary, the miniature seismograph offered several advantages in locating the new route and designing the grade. As a reconnaissance tool, it was able to explore possible problem areas along the route quickly. Its portability permitted the development of accurate subsurface information even in areas of difficult access prior to right-of-way purchase. Further, precise subsurface information permitted greater accuracy in estimating actual construction costs. Cost savings of this exploration method are quite obvious to engineers engaged in such work.

Representing the Minnesota Highway Department at its Duluth District office were: Earl Miller, District Engineer; Norman Schmidt, Assistant District Engineer; Donald Bacon, Materials Engineer; and W. Highmark, Project Engineer. W. R. Liebenow, materials engineer for Ellerbe & Company, supervised the seismic survey; and Robert Kaasa, president, Geophysical Specialties Company, supervised the seismic analysis.



● **SEISMIC sounding along centerline of the proposed northbound route showed bedrock below the grade line. However, in southbound route, which was not mapped by seismograph, rock appeared above the grade line, requiring blasting for removal.**

● **IN TWO WEEKS a two-man crew employing the portable MD-1 engineering seismograph completed a 7½-mile survey for a new route location in a rough area.**

WATER DIVERSION and FLOOD PROBLEMS REQUIRE INGENIOUS CONTROL

● TWO BASCULE gates at Mattapan Mills operate in echelon. As river rises, one gate moves down; then other gate lowers.

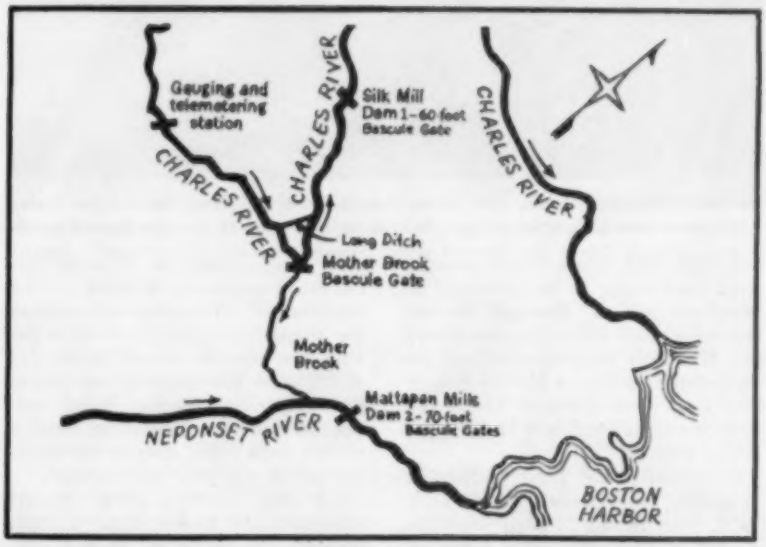
H. A. MAYO, SR.
Representative Northeast Region
Allis-Chalmers Mfg. Co.

A RECORDED agreement filed in 1831 settled a long dispute over water rights between mill owners on the Charles and Neponset rivers near Dedham, Massachusetts. This historic action provided for one-third of the Charles River to be diverted down Mother Brook to the Neponset River and the other two-thirds to flow on down the Charles below Mother Brook. To accomplish this division, submerged weirs were placed in the Charles River below the branch-off of Mother Brook with similar weirs at the same level, but half as long in Mother Brook.

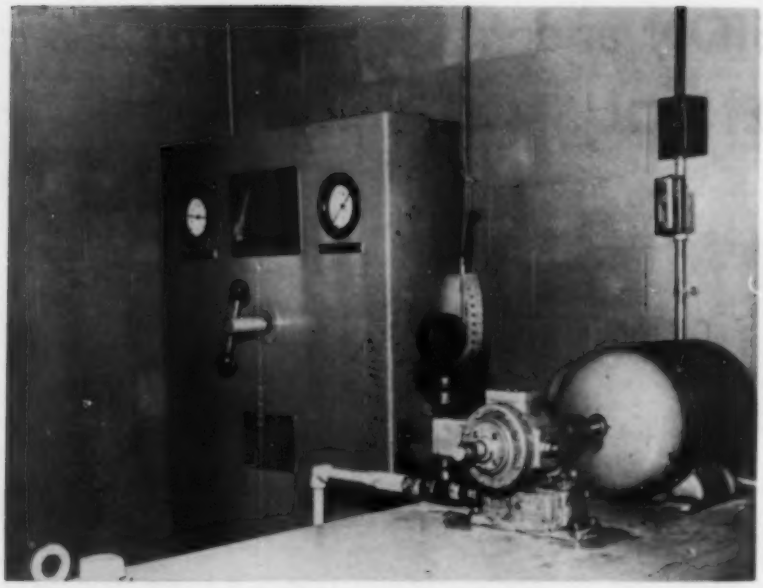
The ensuing years brought changes in the topography of the area with resultant increased flooding. In an effort to mitigate these depredations, Long Ditch across the bend in the Charles River west of Mother Brook was enlarged in 1935. This permitted a freer flow of flood waters to the Silk Mill Dam farther down the Charles River, but at times it also upset the division of flow from the Charles to the Neponset rivers.

In 1955 the Metropolitan District Commission of the Commonwealth of Massachusetts was authorized to work out a control which would satisfy the required diversion of water and protect the low flat areas around these sections of the two rivers, which now included valuable recreational facilities, from flood damage. The equitable partition of waters under the recorded agreement called for ingenuity. The engineering firm of Anderson Nichols & Company of Boston, under direction of the Water Division of the MDC, devised a system to accomplish the required control. It comprises Bascule gates and a control using standard telemetering and gaging station devices with a proportioning arrangement so that the flow, as indicated at a gaging station five miles up the Charles River, is relayed to a proportioning unit at the Mother Brook gate.

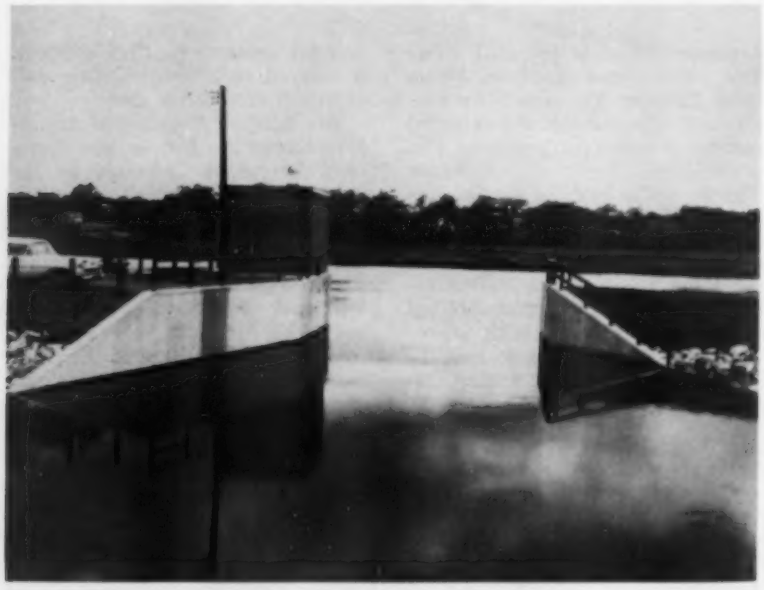
The Mother Brook gate is adjusted until the flow in this diversion channel, as indicated by the level of the water well below the gate, brings the control into equilibrium with one-third of the Charles River flowing down Mother Brook. This control, independent of the level of water in the Charles at Mother Brook, also permits manipulation of the Charles River water levels by a Bascule gate at



● MAP OF general section where Bascule gates are maintaining pool levels to regulate stream flow and safeguard industrial and recreational areas from flooding.



● CONTROL panel and accumulator system at Silk Mill Bascule gate site at Dam No. 1 on the Charles River. This 60-ft. gate stores water in the area above Silk Mill.



● MOTHER Brook control site shows Bascule gate completely submerged during high water period. Function of gate is to divert one-third of river to Mother Brook.

the Silk Mill Dam. This permits flood back-water to be contained in the river channel through the flat recreation and industrial area above the Silk Mill without affecting the diversion of water at Mother Brook. The control is believed to be the only one of its kind for a large regulating gate.

Completing the flood protection program, two Bascule gates each 70 ft. long by 5.3 ft. high were installed at Mattapan Mills Dam, on the Neponset River, to maintain water levels above the dam and yet pass large quantities of water under flood conditions without serious back-water. The construction work for these four gates and their installation was completed in the fall of 1959. The telemetering equipment and control at Mother Brook can not be put into operation until a bridge and control area in the channel below the gate is completed.

All four Bascule gates operate automatically under float control. Heaters are provided at the ends and along the sills to prevent freezing. The two gates at Mattapan Mills operate in echelon so that one does not start to lower until the other is completely down. The gates are actuated by approximately 500-psi oil pressure maintained by motor driven oil pumps operating through powerful servo systems.

For those who may not be familiar with the construction of a Bascule gate, it is essentially a hinged flash board with a horizontal torsion member at the hinge through which the gate leaf is raised or lowered by a hydraulic servo unit or a motor operated mechanism connected to a lever or levers at one or both ends of the gate. The torsion member is provided with machined journals or hinge bearings supported on the crest of the dam.

Control is usually from a float which actuates a balanced pilot valve through which oil is ported to a servo cylinder. Compensation is provided so that each position of the float corresponds to a definite angular position of the gate. A longitudinal rubber seal forms a closure between the crest of the dam and the torsion member. Rubber seals at each end make the gate tight at the piers.

The special proportioning control at Mother Brook is put in motion by the rise or fall of a conventional stream gauging float at the Charles River gauging station 5 miles up the Charles River. This float moves the telemetering transmitter through an adjustable calibrated cam device to provide straight line motion proportional to actual flow. Through two leased telephone wires, this motion is transmitted to the Mother Brook receiver which in turn resets a pneumatic positioner control. This pneumatic positioner moves the hydraulic gate operator control valve to cause the gate to move in the proper direction under the stabilizing control of a compensating linkage. As soon as the modified flow over the Bascule gate affects the position of a float in a well connected down stream from the gate, the proportioning mechanism starts to retard the gate travel until the float reaches the position, previously calibrated, corresponding to the required one-third flow indicated by the Charles River gauge.

This system of Bascule gate controls represents a modern approach to the regulation of a lower river basin. The type of gate is available in a wide range of sizes up to 10-ft. high and 100-ft. or more wide. With modifications, the Bascule gate idea has been designed up to 16-ft. high. A modified design 233-ft. long is in successful operation.

Accidents Reduced
by BRIDGE LIGHTING PROGRAM

WILLIAM F. HALLSTEAD

FOR a city that only recently extinguished and replaced its last gas lamp, Baltimore has come a remarkably long way in street and bridge lighting in a short time. It proudly installed its first gas street lamp in 1865, nearly a century ago. By 1957, all of the gas lights were replaced with modern luminaires. While much additional modernization still lies ahead, the Bureau of Mechanical - Electrical Services, Street Lighting Division, with W. L. Buckingham as superintendent, has done a thorough job with a stringently controlled budget.

Although Baltimore's entire street lighting program is very much "on the go," perhaps the lighting on bridges is the most interesting phase of the overall improvement still underway. The city adheres strictly to IES standards for all new installations and improvements. Lighting is calculated to afford 1.2 foot-candles of illumination on standard bridges (as compared to an average of 1 foot-candle on thoroughfares and 0.8 to 0.9 on expressways within city jurisdiction).

Two years ago, the Division began a program to install modern luminaires on all Baltimore bridges over 100 feet in span. By January, 1960, lighting on all but 8 of the bridges had been brought up to IES standards, and the lighting on the remaining bridges is in the works. This 2-year bridge lighting project is no small order; it involves more than 130 structures.

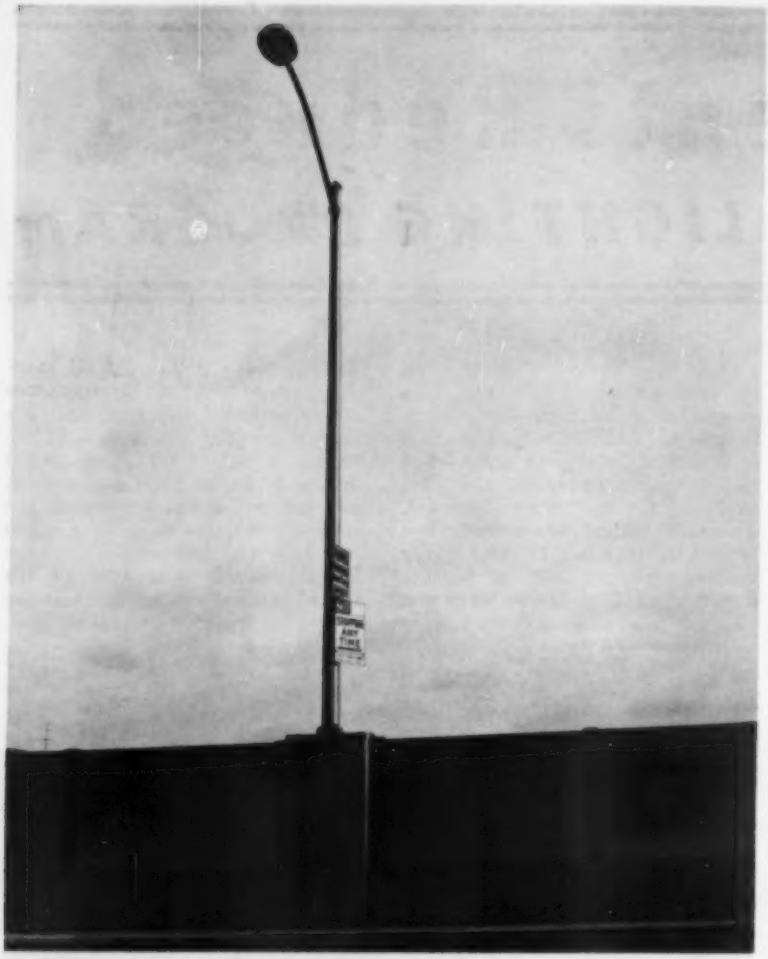
Lighting Problems

Typical of the existing incandescent bridge lighting was the illumination on the St. Paul Street bridge over Jones Falls just north of central Baltimore. Construction of the Jones Falls Expressway required the raising of the St. Paul Street structure. The existing bridge was lighted by frosted glass globes enclosing incandescent bulbs up to a 400-watt maximum. These globes were mounted on 6-foot-high cast iron poles. The poles were clustered in groups of three atop pedestals at each end of the trusses, and four of the globes were mounted along the center of the northernmost trusses. This arrangement was more or less typical of the city's existing bridge lighting, except that a parapet mounting of these same units was perhaps more common. This bridge is currently being replaced.

Paralleling the St. Paul Street Bridge and immediately adjacent to the east, the Calvert Street bridge has already been entirely reconstructed, and its lighting is typical of the new installations. The units are mercury vapor luminaires on aluminum or steel poles. The elevation is 30 feet from the pavement to the center of the luminaire. The new luminaires used throughout Baltimore are practically all mercury vapor units, both Westinghouse and General Electric, ranging in intensity from 10,000 lumens to 12,000, 19,000, 20,000, 21,000 and 35,000 lumens depending upon bridge width and traffic density. Provisions are made upon installation to provide for future intensification of the lower-powered units through the use of larger-than-minimum cables and ballast with taps that are interchangeable with the wattage of the lamps. The most common new installation is the 20,000-lumen type.

The average maintenance cost for the new mercury vapor lighting on 1,000 feet of bridge is about $750 per annum. The same maintenance on 1,000 feet of the obsolete incandescent lighting runs about $600; however, the mercury vapor installations provide about 10 times more illumination. Maintenance is pre-

● NEW CALVERT St. bridge over Jones Falls, and adjacent to old St. Paul St. bridge, is typical of Baltimore program. Lights are mercury vapor, 21,000 lumens.



● VIEW SHOWS typical new parapet-mounted aluminum pole supporting mercury vapor luminaires 30 ft. above street. This installation is on new Calvert St. bridge.

● AMONG last of Baltimore's bridges to be modernized is the St. Paul St. bridge over Jones Falls. Lights were in groups at ends with four globes at truss centers.

dicated on 3 services: 1) Supply of electricity and rental of wire; 2) rental of fixture and time switches or photoelectric controls; 3) inspection and renewal of lamps and glassware.

The average cost of street lighting per lamp in Baltimore decreased from $65.52 in 1957 to $57.29 in 1958. The average per capita cost of street lighting decreased from $3.55 in 1957 to $3.14 in 1958. By the end of 1958, Baltimore had 53,833 street lamps in service, and the Street Lighting Division's expenditures totaled $3,084,-115. (Of this, $94,362 was allocated to expenses involved in signing streets, also under the jurisdiction of the Street Lighting Division.)

In 1959, the total electric street light operating expense in the City of Baltimore for all installations (some 54,000 lamps) was $2,804,000. This was about $52 per light. Such an average is not too accurate, however, because the total includes new and old lamps; mercury vapor, incandescent and a few fluorescent units. Of the 54,000 installations, the City of Baltimore owns 3,000, including all wiring and equipment. These are maintained and operated by the Welsbach Corporation under contract. The rest are owned by the Baltimore Gas and Electric Company.

Accidents Reduced

The most outstanding effect of Baltimore's bridge lighting modernization program has been the sharp reduction of accidents on the bridges involved. In several locations, this drop has ranged up to an estimated 85 percent in injury and property damage accidents. As far as fatalities are concerned, Mr. Buckingham knows of none on the bridges that have been relighted in the current program. This is particularly rewarding to the city lighting and traffic engineers. All lighting modernization—except, of course, for special situations like the Jones Falls Expressway construction—is based upon priorities drawn from the night accident fatality statistics supplied by the Bureau of Transit and Traffic.

It is difficult to make a clear-cut comparison of accident statistics on a given bridge before and after the lighting has been upgraded. Almost all modernization has included the reduction of other hazards as well as inadequate lighting. Many of the old bridges had center trusses separating opposing traffic lanes, and these unfortunately contributed to many night-time accidents even when lighted at each end with warning blinkers. The removal of

● **TYPICAL of the new mercury vapor lights are those on the new Charles St. bridge. The 30-ft. poles are spaced according to bridge width and overall traffic conditions.**

center obstructions and other hazards, along with the improved lighting, make it difficult to determine in accurate figures the contribution of improved bridge lighting to the sharp drop in accidents on the 130 or so bridges treated thus far. Removal of physical hazards often increases the speed hazard. It is then the responsibility of the Street Lighting Division to reduce this speed hazard through improved lighting.

The following figures will serve as a fairly accurate example of a dramatic reduction in accidents following modernization. In 1955, there occurred on the Calvert Street bridge a total of 8 reported accidents involving injury and/or property damage. In 1956, there were 9. In 1957, the bridge was replaced, taking it out of service most of that year. It was reopened in 1958 with lighting designed to meet IES standards. The accident total in 1958 was just 1. Another single accident occurred in 1959. This drastic reduction in accidents—almost 90 percent from 1956 to 1958—cannot be attributed solely to street lighting improvement, of course. The totals include both day and night accidents, and the bridge replacement involved the removal of a physical hazard. Nevertheless, the accident reduction on this Calvert Street span follows a pattern set throughout the city: where bridges have been replaced, revised and relighted, the accident rate has dropped to a marked degree.

With over 90 percent of Baltimore's major bridges carrying modern 1.2 foot-candle illumination, and with the few remaining bridges slated for up-graded lighting in the near future, the city's newspapers appear justified in claiming the best-lit bridges in the nation. The sharp reduction in accident rates on newly-lit bridges is enough in itself to lend credence to the statement.

RESIDENTIAL STREET PAVING *by* SPECIAL ASSESSMENT

RICHARD R. HINES
and
B. J. ADKINS

Mr. Hines and Mr. Adkins are members of the Engineering Department of the City of Peoria, Illinois. This article was edited and submitted by A. J. Pfeiler, former City Engineer of Peoria.

RESIDENTIAL street paving by Special Assessment is initiated in Peoria upon receipt of a petition to the Board of Local Improvements from the property owners on the street to be paved. The petition is checked to determine the percentage of frontage and authenticity as to ownership of the signers. If more than one-half the property frontage is represented on the petition, the City Engineering Department surveys the street, and plans, specifications, and an estimate of cost for the project are prepared.

A notice of public hearing is then sent to the property owners giving the time and place of the public hearing and all information concerning the project, including the property owners' assessment per front foot. At the public hearing, the project is described by the Secretary of the Board of Local Improvements and the audience is invited to discuss any problems or questions they may have concerning any phase of the project. After the public hearing the Board of Local Improvements sends its recommendation to the City Council, along with an ordinance for the improvement, for consideration by the Council. If approved by the Council, the estimate of cost, the ordinance, and the assessment roll are filed in the County Court petitioning for approval of same. After this has been done, a Notice of Special Assessment is published in the newspaper and copies are mailed to the affected property owners and other interested parties such as utility companies. The next step is filing an affidavit of Proof of Publication, an exhibit of the Special Assessment Notice, and a Certificate of Publication of the Notice of Special As-

● **SCARIFYING is first step in construction process; it follows such preliminary work as the soil survey, removal of street castings and improvement of the soil mix.**

sessment in the County Court. Affected property owners are allowed to file objections to the improvement up to and including the date and time set for the County Court hearing as had been published not less than 15 days nor more than 30 days prior to the date of the hearing. If no objections are filed, the County Court approves the petition through default and confirms the assessment roll. The Secretary of the Board of Local Improvements is then instructed to advertise for sealed bids to be opened not less than 15 days following the advertisement.

Following the award of contract, the contractor is allowed a period of 15 days to execute the contract documents and furnish approved contract bond and an additional 10 days in which actually to begin work. There is also a specified time limit for actual completion of the project incorporated in every contract which protects the City from damages should the contractor fail to complete the work within the specified time.

The construction is done in accordance with the "Standard Specifications for Road and Bridge Construction" of the State of Illinois, Department of Public Works and Buildings. These specifications are supplemented by City of Peoria standards and special provisions where necessary. In 1955 the Board of Local Improvements imposed minimum residential street pavement requirements calling for a 6-in. soil cement base with an average 1½-in. surface of bituminous concrete with portland cement concrete combination curbs and gutters and adequate drainage facilities. This action insures uniform quality in residential street paving.

Construction Procedure

Construction starts with the excavating or filling required to bring the existing surface to grade. Portland cement concrete curbs and gutters are then constructed, usually at a width of 30 ft. from face to face of curbs. After storm water drainage structures (if any) are completed, the soil cement base construction is begun.

Soil cement, a blend of soil and portland cement tightly compacted while in a moistened condition and prior to hydration of the cement in the mixture, produces a durable, weather-resistant, rigid base at low cost for roads bearing light traffic. Each construction season for the past several years has brought an increase in the use of this type of base for streets and roads in our residential areas. Topped with a bituminous-type surface course, the soil cement street has given satisfactory service with low initial and maintenance costs over a period of several years.

The first step taken toward the construction of the soil cement street is the soil survey. Determination of the type and texture of soil in place is necessary to find the percentage of cement required to produce a stable base. Possible need of additional granular material or even the inadvisability of soil cement construction might be brought out by this survey. In Peoria, a city-wide soil survey, made by the Engineering Department with the assistance of the Portland Cement Association, is helpful. This survey involved the collection of representative soil samples from various areas of the city. Analysis of these samples provided the information required to designate on a city map the various areas of the city according to soil type and cement requirements. Soil analysis of the individual project is also necessary for accuracy in determining project requirements.

The finer the texture of the soil, the more cement is required to produce a satisfactory base product. Our experience indicates that sandy soils require 7 to 12 percent of cement to soil material. Where silt or clay predominate, a 12 to 16 percent cement to soil ratio is used. Soils of a very fine texture would require a high percentage of cement and the addition of granular materials. Since soil cement is favored because of its low cost, the increased expense of adding materials or using a very high cement to soil ratio is seldom justified in favor of other types of base construction. In Peoria, the average cement content of the soil cement mixture determined by requirements is 12 percent by volume.

Preliminary work is completed before processing for soil cement occurs. Infrequently, some granular material is added to improve a poor native soil. All castings are removed to storage; locations of manholes, lampholes, water and gas boxes recorded; and openings covered at a depth of 8 to 10 inches below finished grade. Soil material in place is then cut and shaped to the desired crown on the rigid base. Our soil cement process is a one-day operation. Because of the nature of soil cement, the mixture of native soils, bulk cement and water must be completely processed before work is stopped and initial setting action takes place. The following sequence of operations takes place: 1) Scarification; 2) pulverization; 3) application of cement; 4) dry mixing of soil and cement; 5) application of water; 6) wet mixing of soil and cement; 7) compaction; and 8) curing.

Scarification is accomplished by a motor grader. Making several passes over the roadway, the grader breaks the soil with the scarifier in preparation for pulverization and to reveal large hidden objects which should be removed from the processing area.

Pulverization is accomplished by means of a rotary speed mixer. Because the mixers cannot operate closer than 4 to 6 inches from the gutter flag, it is necessary to use a tractor-drawn plow to turn the soil away from the gutter flag into the path of the mixer. The equipment is followed by laborers who remove stones larger than 3 in. in diameter and foreign objects turned up by the mixer. Pulverization continues until the following specifications are met: 1) 100 percent of the soil, by dry weight, passes a 1 inch screen; and 2) 80 percent of the soil, by dry weight, exclusive of gravel or stone retained, passes a No. 4 sieve. The key to good pulverization is a low moisture content in the soil to be worked. Under extremely dry conditions, an 800 foot processing area of 27-ft. width has been pulverized to specifications by two rotary speed mixers in under two hours time. Under conditions of high moisture content, a 400-ft. processing area of 37 ft. width has taken over six hours with three rotary speed mixers in use. Because practical operation of a one-day process requires that pulverization be accomplished in about two hours, aeration of the soil prior to the day of soil cement processing is recommended when moist conditions exist.

Application of cement is then distributed in the required amount uniformly over the processing area. To do this we use a mechanical spreader capable of laying a uniform depth of cement the width of the spreader. For dry mixing of soil and cement, the same rotary speed mixers employed in pulverization are used. Speed and thoroughness of dry mixing are dependent upon the degree of pulverization previously attained. Mixing of the cement with soil takes place in layers, each pass of the rotary speed mixer distributing cement uniformly throughout the soil at a successively lower depth. Dry mixing is complete when test holes throughout the processing area indicate that the cement has been mixed with soil to a depth of 8 inches in the loose material. During the mixing operation, it is necessary again to use the tractor-drawn plow to turn soil and cement adjacent to the gutter flag into the path of the mixer. The grader blade is also used during the mixing operation to maintain the shape and crown of the material worked. Application of cement and completion of the dry mixing operation is generally performed in approximately two hours for the average daily processing area of 800 by 27 ft. Thus far, four hours of the average processing day have been consumed.

● **FINAL rolling with flat wheel roller follows shaping and cutting with motor grader and leaves base smooth. Processing should be completed in an 8-hour period.**

Application of water is the next step in construction. The amount necessary to bring the soil cement mixture to optimum moisture content is applied to the mixture by means of a self-propelled water pressure distributor capable of delivering 100 gal. per minute from a tank capacity of 1000 gal. or more. Uniformity in distribution is essential to prevent dry areas, in which insufficient compaction and hydration would take place, or wet spots, which would require undue time to work out of the mixture before proper compaction could be attained. Hand hose application of water may be found necessary at intersections and other spots where poor maneuverability of equipment makes use of the distributor difficult. Spot checking begins as soon as water is applied, and continues until the engineer is satisfied that optimum moisture conditions exist throughout the soil cement mixture.

Wet mixing of soil and cement takes place in conjunction with water application. Rotary speed mixers follow behind the water distributors to assure a smooth blending of water, soil and cement. To permit compaction before hydration of the cement occurs, the application of water

(*Continued on page* 181)

● **SPREADING cement and mixing. Standard procedure utilizes mechanical spreaders and rotary mixers. Application of cement and mixing normally take about 2 hrs.**

CITY OF OAKLAND DEVELOPS NEW RAINFALL INTENSITY–DURATION CURVES

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Material for this article has been taken from the "Report on Rainfall Intensity-Duration Curves for the City of Oakland," compiled by L. A. Fites, Assistant Engineer, which is on file in the Engineering Department, City Hall, Oakland, California.

A RECENT REVIEW of all the operations and standards in the Engineering Department revealed the need to revise the Intensity-Duration curves used by the City of Oakland, Calif., in the rational method for storm culvert design. The preliminary investigation indicated the possibility of a 10 percent reduction in intensity values previously used. Final results showed a decrease in the intensity values of approximately 14 percent. The use of these reduced intensity values will save the City $24,000 annually.

The original rainfall study for the City of Oakland was developed in 1927; revised in 1937; and the following is a brief account of the 1958 Intensity-Duration curves now being used.

Available Information

Research for this study revealed available information from several sources. However, the data used in the development of the new rainfall curves was taken exclusively from the Chabot Observatory records (1905-1944) and the Upper San Leandro Filter Plant records (1944-1959). These two stations are geographically closer than any two other stations and their records were combined and used as a single set of data covering the period of record. The U. S. Weather Bureau records (1937-1959) at the Oakland Airport were equally dependable, but this station is located far from the major area of the City and from adjacent stations. It was felt that the data from this station would not be as representative for the City as the data chosen.

The gross period of automatic rain gage records was 54 years—from April 1905 to January 1, 1959. Rainfall records during the years 1918 and 1919 were not available and these years were substantiated by other local stations to be periods of heavy rainfall. These two years, therefore, have been omitted from the period of record, leaving a net

Number of Storms of Equal or Greater Intensity During Period of Record (1905-1959, 52 Years Excluding 1918 and 1919)

t	INTENSITY IN INCHES PER HOUR																								t
HRS-MIN	.10	.12	.14	.16	.18	.20	.22	.24	.26	.28	.30	.40	.50	.60	.70	.75	.80	.90	1.00	1.25	1.50	1.75	2.0	2.5	3.0	3.5	4.0	HRS - MIN
5																					49	–	23	9	5	2	1	5
10																					18	–	5	2	1	Θ		10
20																				9	3	3	Θ					20
30																			8	4	1	Θ						30
40																17	–	–	6	1	Θ							40
1-0																7	–	–	3	Θ								1 – 0
2-0												14	7	4	3	–	1	Θ										2 – 0
3-0											16	6	3	2	1	–	Θ											3 – 0
4-0						30	–	–	–	–	8	3	2	1	Θ													4 – 0
6-0						23	18	13	10	5	3	1	Θ															6 – 0
12-0	41	33	25	15	8	5	3	1	Θ																			12 – 0
24-0	18	8	3	1	Θ																							24 – 0
RECURRENCE INTERVAL ——								10 YEAR			15 YEAR			25 YEAR			50 YEAR										
FACTOR FOR A 52 YEAR PERIOD								5.20			3.47			2.08			1.04										

FIG. 1

● **TABULATION** of rainfall data collected in Oakland, California, showing the number of storms of equal or greater intensity.

period of 52 years. It may be observed that if storms during the years 1918 and 1919 were great enough to affect the curve, an error is introduced into any curves that neglect these storms. As the period of record is increased, however, the effect of this omission is reduced and the error in the new 1958 curves is probably insignificant.

Using Information

The automatic rain gage records were tabulated for maximum amounts of rainfall recorded during periods of 5, 10, 20, 30 and 40 minutes and for periods of 1, 2, 3, 4, 6, 12 and 24 hours. This information was then converted to the actual rate of rainfall in inches per hour.

A table, Figure 1, was arranged with the number of storms equalling or exceeding each rate of rainfall for a given time interval. Rates were placed in convenient values ranging from 4.0 to 0.10 inches per hour. The theoretical rate of rainfall or "intensity" (in inches per hour) that would be equaled or exceeded but once in a given number of years was then computed.

As an example, the intensity of rainfall may be computed for a 10-minute interval in a 15-year storm. Since the table covers records of 52 years, the value of 52 divided by 15 or 3.47 may be used for a 15-year storm for any time interval. During the period of record, a 10-minute rainfall of 2.5 inches per hour occurred 2 times and a rainfall of 2.0 inches per hour occurred 5 times. By interpolation between these figures it is determined that the actual intensity of a 15-year storm is 2.26 inches per hour for a duration of 10 minutes.

These 15-year storm intensities for each time interval were then plotted on log-log paper with time versus the reciprocal of intensity, as shown in Figure 2. The curve through these points closely approximated a straight line, and a logarithmic equation was developed for the best fit to the actual data.

In fitting the equation to the actual curve, percentages of difference were used instead of the more involved sum of least squares. The percentage of difference provided satisfactory results for the purposes of this study. The summation of the percentages of difference were minimized for the best slope of equation, and the minimum net percentage of difference located the best ordinate of the equation line for a given slope.

The 15-year formula was then modified by an appropriate factor for application to the 10 and 25-year curves, again using the percent of difference to determine the best equation. The modification is valid, since the intensity-duration curves are similar when plotted on log-log graph paper.

Since the theoretical intensity values for the 50-year curve approached the maximum intensity values tabulated and since these values were erratic, the 50-year logarithmic formula was determined by using an extrapolation chart with 10 minute values for a 10, 15 & 25-year recurrence. These were plotted on log-log paper and then projecting a straight line to determine the 10 minute intensity values for a 50 and 100-year recurrence. The balance of the 50 and 100-year intensity-duration curve was computed using a logarithmic equation which yields results that conform to the pattern of the 10, 15, and 25-year intensity-duration curves.

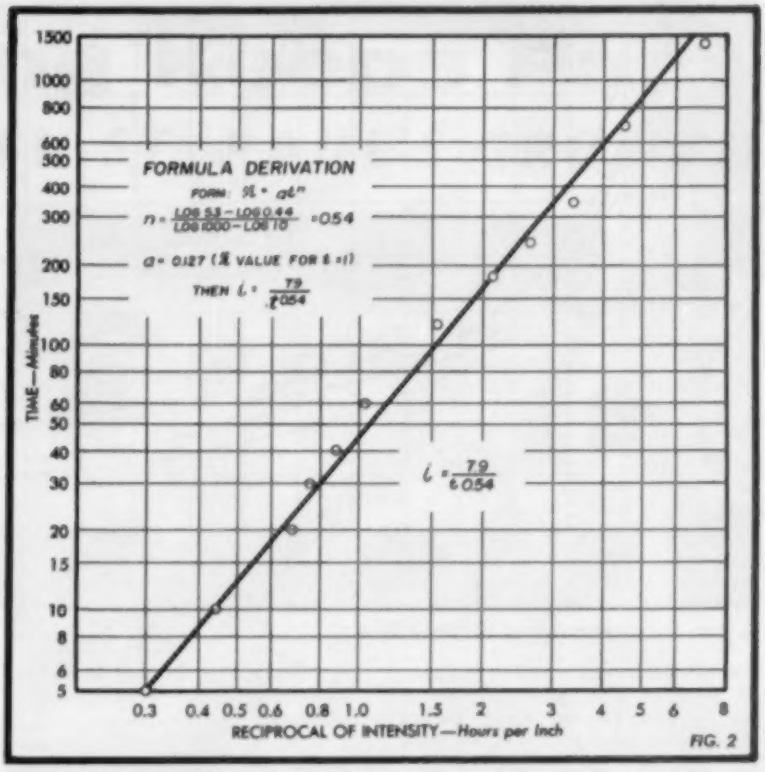


FIG. 2

● **15-YEAR STORM Theoretical Intensit/-Duration Curve. This combines actual 1958 plot and the 1958 logarithmic intensity-duration curve for 15-year storm.**

Results

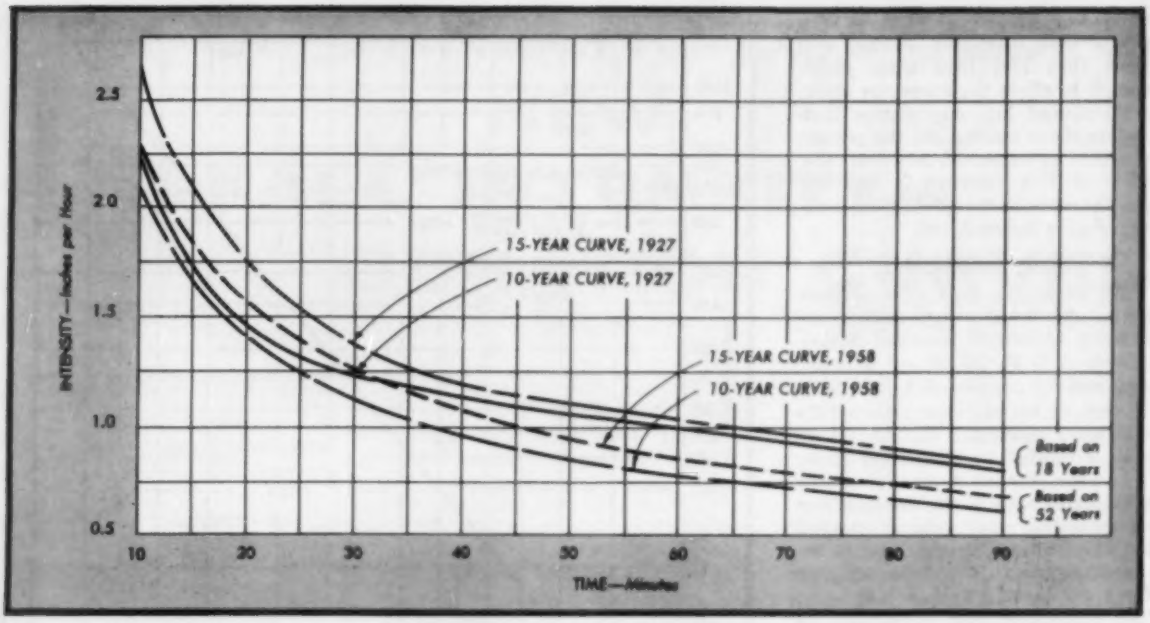
These logarithmic formulas have been adopted as the best practical equations to fit the rainfall pattern in the City of Oakland from 1905 to 1959. In addition, some simplified formulas were developed for periods up to 60 minutes. Table 1 lists our adopted logarithmic formulas for periods up to 24 hours and the simplified formulas satisfactory for periods to 60 minutes in duration.

A comparison of the 1927 and the new 1958 Intensity Curves between 10 and 60 minutes for the 10 and 15-year design storm is illustrated in Figure 3. This shows an average

Table 1—Logarithmic Design Formulas and Simplified Formulas for Rainfall Periods Up to 60 Minutes Duration

Adopted Formula	Design Storm	Simplified Formula
$i = 7.1/t^{.54}$	10-year	$i = 6.4/t^{½}$
$i = 7.9/t^{.54}$	15-year	$i = 7/t^{½}$
$i = 8.9/t^{.54}$	25-year	$i = 8/t^{½}$
$i = 10.5t^{.54}$	50-year	$i = 9.2/t^{½}$
$i = 12.5/t^{.54}$	100-year	$i = 11/t^{½}$

NOTE: i = intensity in inches/hour
t = time in minutes



● **FIG. 3. COMPARISON of 1927 and 1958 intensity curves. Average decrease for values to 60 minutes is about 14 percent.**

decrease in intensity values of about 14 percent. Comparisons between the 10 and 15-year storm values were made because the two curves are used by the Engineering Department for hilly and flat land storm culvert design. This decrease of 14 percent in the intensity values will reflect a savings of approximately $24,000 annually for storm culverts constructed in the City of Oakland, which may be explained as follows:

At the present time, the Engineering Department designs storm culverts using the rational method. The diameter of pipe has a direct ratio to the $\frac{3}{8}$ power of Q. A decrease in Q by 14 percent would result in the decrease of pipe size required by 5.5 percent. Assuming pipe installation cost at approximately 75 percent of contract costs, the net saving would be approximately 4 percent. Annual storm conduit construction cost for the City of Oakland since 1956 averages approximately $500,000, which would reflect a savings of $20,000 at 4 percent. Annual storm conduit construction cost by private contract averages approximately $100,000, which would reflect a savings of $4,000 at 4 percent. Thus, a total savings of approximately $24,000 annually would be expected for storm conduit construction.

Rational Design Method

[The following discussion of the Rational Method as used by the City of Oakland has been abstracted by the Editors of PUBLIC WORKS from the "Report on Rainfall Intensity-Duration Curves for the City of Oakland."]

At the present time the Rational Method is used throughout the City of Oakland for storm flow computations. Accepted practice elsewhere is to use this method for areas up to only 1000 acres, and the assumption of even rainfall distribution throughout the area as used in the Rational Method is generally valid only for areas up to 200 acres. To use this method for areas larger than 200 acres will usually yield conservative results. More realistic values of storm flow for the design of large culverts could probably be achieved by using other methods, such as the storm flow hydrograph.

For designs where the Rational Method is used, all the variables should be studied in order to obtain factors that will be of the same order of accuracy as the intensity factor, and consistent with good engineering practice.

Design Storm. In some cases economic studies equating the cost of structures to the potential damage from a given intensity storm will indicate that the use of a design curve other than the 10 or 15-year curve may be in order. Such a study would be very tedious and involved and could be justified only when dealing with very flat or confined areas.

Time of Concentration. Minimum time of concentration in use today varies from city to city and a more scientific analysis of this factor should be made to bring it in line with the precision of the intensity values. The benefit of an accurate intensity figure is diminished if the minimum time of concentration is only an estimate made without regard to particular features of the specific problem.

Example:	Minimum time of Concentration
Oakland,	t = 10 minutes
San Francisco	t = 5 minutes
Richmond uses logarithmic equation	
Alameda County Flood Control	t = 10 minutes

Runoff Coefficient. Much detailed study has been made of runoff coefficients. By taking full advantage of this research and making detailed observations of tributary areas when establishing coefficients, engineered solutions that utilize the optimum of available knowledge will be achieved. Increasing use should be made of available aerial photographs as a general aid in the analysis of storm drainage problems.

Example:	"C" for Multiple Family Area
Oakland,	C = 0.70
San Francisco,	C = 0.60—0.70
Richmond,	C = 0.50
Hayward,	C = 0.70

Above all it should be recognized that successful use of the Rational Method depends on the skill and judgment of the engineer.

Surveying Keeps Pace
WITH ST. PAUL'S GROWTH

EDWARD L. O'CONNOR

Mr. O'Connor, who served as Assistant Chief Surveyor, Bureau of Engineers in the Public Works Department of the City of Saint Paul, Minnesota, prepared this article in draft form before his recent death. It was edited and submitted to us through the courtesy of Eugene V. Avery, Chief Engineer of the Public Works Department.

THROUGHOUT recnt history the practice of surveying has played an essential role in the proper establishment and construction of public improvements. Surveying in Saint Paul, Minnesota, with respect to its principal assignments and activities is similar to those activities in most other municipalities. However, in certain interesting aspects it is somewhat different.

A complete survey of the city was made about 60 years ago as a result of action by foresighted city officials. The standard procedure in Saint Paul of relating or "tying-in" survey lines to section lines or quarter-section lines is thus comparatively simple. The survey conducted around the turn of the century called for setting granite monuments at all of the section corners and quarter-section corners. Many quarter-quarter corners were also monumented, as well as the harbor line of the Mississippi River (which divides the major portion of the city from that part lying to the south known as Riverview). About five years were required to complete the survey— a relatively short time when it is considered that photogrammetric methods were not available and that Saint Paul embraces some 55 square miles including 3½ square miles of water. The so-called "seven hills" of Saint Paul made the survey even more difficult, since elevation ranges from 684 ft. to 1045 ft. above sea level. Standard maps made from the notes of this survey are regarded and used as the "Bible" of surveying for the City of Saint Paul. Through the years, many of the monuments have been lost, some because of carelessness on the part of contractors, others because they were located in the path of construction projects or for a variety of reasons. Whenever it is discovered that a monument has been lost or disturbed, a notation is made to that effect, and when time permits, the surveyors reestablish the lost corner.

● **AFTER: St. Paul's capitol approach as it is now after the enlargement and revision. Compare picture below and note revised street pattern and new buildings.**

● **BEFORE: View taken about 1920 shows capitol approach before improvements.**

In addition to the maintenance of the old monuments, Saint Paul like so many other cities, is confronted with the problem of establishing and holding a sufficient number of permanent bench marks. In order to avoid running time-consuming levels for long distances, the ideal situation would be to establish bench

● **CORNER monument. This granite corner marker, 8 by 8 by 30 ins. is used at section and quarter section corners.**

marks about 600 to 1000 ft. apart. Very little time would thus be required in establishing an elevation. With this purpose in mind the City of Saint Paul has endeavored to set bench marks on top of all fire hydrants. Ordinarily, because of their rigidity, fire hydrants make ideal bench marks. Unfortunately, with the widening of many streets in a large improvement program, many hydrants are moved to new locations. This necessitates the changing of records to show the new elevations of the hydrants. It is standard practice for the Public Utilities Department to notify the City Engineer's Office whenever a hydrant is moved. The new elevation is then determined and recorded by a survey crew.

The surveying section is a division of the Bureau of Engineers which is a part of the Public Works Department. The department is currently headed by Commissioner Adrian P. Winkel, an elected official. Eugene V. Avery was recently appointed City Engineer to succeed the late Arthur W. Tews. George M. Shepard, earlier City Engineer, presently occupies the post of Street and Highway Engineering Coordinator. Mr. Shepard served as City Engineer for the greater part of the time between 1923 and 1957, during which period the surveying organization as it operates today was formulated. Irving S. Forsberg, whose tenure of service also started in 1923, supervises the work of seven survey parties as Chief Surveyor. Each party consists of a surveyor, an instrumentman and two or three engineering aides. All crew members are civil service employees who have passed competitive examinations.

Because of the relatively cold climate, the construction period for paving, grading and sidewalk work extends from April through November. During the construction season, two survey crews are assigned to paving projects, two crews to the grading of minor streets, one to sidewalk work, and the other crew to assist wherever the need is greatest. One survey crew is permanently assigned to sewer work which is carried on throughout the year. The other crews are occupied during the non-construction months with preliminary surveys for work to be undertaken later and such jobs as mending tapes, cutting stakes, painting level rods and range poles. The instrument room, located in the basement of the City Hall, is equipped with a power saw and ample space for storing stakes. The city contracts for 2-in. by 1-in. by 4-ft. stakes in carload lots, one of which lasts about a year.

A major recent project requiring extensive surveying activity is that known as the Capitol Approach. Here a large area was cleared of sub-standard housing, and new streets and building locations were established. Because of the size of the territory involved and its housing congestion, it was necessary to make a closed traverse survey of the area. A coordinate system was then used to control a development of the overall plan including the street network. Here again, the survey was tied in with the monuments set some 60 years ago.

Stillwater Road is another major project for which the surveying was typical. After the City Council approved the Preliminary Order, a survey was requested in order that a cost estimate could be made. The survey was made by tying-in each terminus to the nearest section line. The centerline was run out and all trees, driveways and structures that might be affected were located with reference to this centerline. Cross sections were taken at intervals not exceeding 50 ft. The notes were then turned over to a member of the engineering staff who prepared preliminary plans and estimates. After the required public hearing and approval by the Council, plans were drawn and a contract let.

When the contractor was ready to begin work, the surveyors again set centerline stakes and, as the work progressed, set line and grade stakes for the paving and curb. These stakes were driven at convenient offsets and at intervals not exceeding 50 ft. on the tangent and 25 ft. on the curves. Radius points at all intersecting streets, alleys and driveways were also set by the surveyors.

● **CORNERS aren't always located in such places as this, though it may seem to the surveyor that they are. This shows tie-in to section corner for paving project.**

The Stillwater project cost approximately $192,000, financed about 64.5 percent from County Aid, 16.7 percent from Municipal State Aid, and the balance of 18.8 percent from assessments against abutting property. This financing procedure, utilizing a variety of funds, is typical of most major projects. From time to time, other sources of revenue include Bond Issue Funds, Budget Funds (which are the City's share for local improvements) and State Highway Funds (to cover joint projects of the city and state). Railroads and the local Transit Company, when they are involved, also participate in the financing of city work.

During 1960, the City of Saint Paul anticipates an expenditure in excess of $10,000,000 in road, bridge and sewer construction. The important role of surveying in properly controlling the accomplishment of this vast program is self-evident.

Stumped by Your Stump Problem?

R. H. VAN DEUSEN
Township Manager,
Mount Holly, New Jersey

● MACHINE will take out 20 to 30 stumps per day, depending on the size; average stump is removed in 15 or 20 min.; average cost is 75 cents per inch diameter.

RECENT IMPROVEMENTS in the art of stump removal have lifted this municipal function from the stone age to the twentieth century in one giant stride.

Previous to the development of the modern stump cutter Mount Holly, New Jersey, had used the time honored method of "dig and chop," otherwise known as "root, hog, or die." A large stump sometimes took three or four men, a truck, lots of cable, a front end loader, axes, shovels, power saws and about two full days. If it was wedged between sidewalk and curb it took another day, plus pavement and sidewalk replacement cost. If you had a lot of patience you could treat the stump chemically and wait till it rotted out. Either way it took a lot of time or a lot of money.

Recently, we became interested in the Vermeer Stump Cutter manufactured in Pella, Iowa. We decided we wouldn't have enough work to keep such a machine busy over a period of years, so we talked to a nearby tree surgeon about a guarantee of $500 worth of business each year for four years. We suggested he proposition two other communities about a similar understanding. This he did, successfully. With an assured $6,000 worth of business over a four-year period the tree surgeon invested approximately $3,000 in the Vermeer equipment.

10-In. Stump = $7.50

Our agreement with the tree surgeon was that he would charge us not over 75 cents per diameter inch, measured across the top of the stump six to twelve inches above the surface of the ground. We try to cut our trunks off within that range above grade to save time in cutting out the stumps. The Vermeer stump cutter can straddle higher stumps, but the higher the stump the more cuts necessary for removal and the longer it takes to get the stump out.

On the basis we are using we have actually spent about $600 per year and the tree surgeon has removed stumps in excess of the 800 diameter inches which 75 cents per diameter inch would pay for. Since a stump is not round, we measure a maximum and minimum diameter and take the average. Thus a stump measuring 30 inches one way and 26 inches another way is added into the total as a 28-inch stump. To save any argument the tree surgeon has been cutting approximately 1000 average diameter inches for the $600 annual fee.

A very small stump of 6-in. diameter costs us $4.50 to remove and a 48-in. stump costs us $36.00 to remove. I think everyone experienced with stump removal will agree that these costs are very low. The machine will do an average 15-in. to 20-in. stump in about twenty minutes and will take out between twenty and thirty stumps a day, depending on size.

The machine consists of a hydraulically controlled, power driven, cutting wheel that can be lowered for successive passes over the stump and travels crosswise to complete each "bite." It goes right down into the ground and eats out the heart of the stump and the roots below ground soon perish. The small chips fill the cavity left by the removal process. These soon rot down and become part of the surrounding earth. Within one season a new tree can be planted in the same spot.

The design of the machine permits working right up to the edge of curb and sidewalk as the cutter makes each pass across the stump. Heavy screening around the operation prevents injury from flying chips. The only other equipment needed is a street broom to sweep the chips from the walk into the stump cavity.

Had we been unable to locate a tree surgeon willing to purchase the machine, we planned to purchase it ourselves and rent it out to other cities and to individuals. On private work the income producing potential of the machine is such that we believe it can be quickly amortized.

BRIDGE WIDENING PROGRAM GETS PUBLIC PRAISE

CHARLES D. MILLER
Field Engineer of Maintenance
Indiana State Highway Department

IN JULY of 1955, a series of localized accidents on Indiana Route 427, north of Fort Wayne, initiated one of the most versatile and popular programs ever undertaken by the Indiana State Highway Department. A weekly recurrence of serious to fatal accidents on a narrow bridge at this location was completely erased when the Fort Wayne Sub-District crews cut off the massive concrete handrails and bolted posts with guard rail on the sides of the floor slab, causing a widening from 19′2″ to 22′3″ on a 22′ concrete pavement. Total cost was only $323. The immediate success of this project resulted in a two-year legislative appropriation of $1,000,000 to initiate statewide elimination of small bridges with handrails closer than 5 ft. from the traveled surface.

The first structure on which precast concrete slabs were used was scheduled for widening on November 30, 1955. On that date, forty supervising engineers who had been attending a convention at French Lick Springs Hotel gathered at the site on Route 235, 1.85 miles north of Medora, Indiana, and watched the crew supervised by Carl Kramer, Project Engineer of Seymour district, place the four precast slabs on a previously-set timber pile abutment. This changed a dangerous 19′2″ wide restriction to a safe modern 34′ structure. Total time of road closure—1 hour and 20 minutes. Total cost—$2,376.50.

District Crews Organized

The demonstrated ease and economy of widening the test structure impressed the six district engineers attending. Each district then organized crews to start the elimination of narrow and substandard bridges under 40′ spans. Since the first structure was placed in July of 1955, 1,030 bridges have been widened and replaced under the program for a total of $3,315,096.45, or an average of $3,218.54 per structure. The reconstruction varies from the simple type described above to complete removal and replacement of steel trusses up to 140 feet long. To date, the most expensive was the replacement of a 130′ truss with three spans of 40′, 50′ and 40′ prestressed slabs. Total cost was just under $30,000 on this structure.

The structures widened to date have covered almost every type existing in Indiana. For recording purposes the Highway Department has listed them as: 1) Structures replaced by precast and prestressed slabs—80 costing $1,421,000; 2) structures widened by prestressed slabs—664 costing $1,196,000; 3) structures replaced with corrugated metal pipes and arches—162 costing $646,000; 4) structures widened with corrugated metal pipes—64 costing $26,880; and 5) structures

● **BRIDGE failure caused by flood waters. This structure is rather typical of the older and often inadequate bridges which have been replaced with modern units.**

● **REPLACEMENT of the bridge shown above. The work included widening of the channel by 10 feet, some ditch realinement and the new structure. Total cost was $8,367. Bridge was also widened and railings built, providing improved safety.**

widened by removal of handrails and replacing with guard rail—60 costing $25,600.

Several times during the program the bridge crews have proven outstanding in their efforts to alleviate an emergency situation. In June of 1957 an urgent appeal was made to the maintenance department to reconstruct a bridge on Route 421 south of Monticello so that the usual holiday crowd could get into the resort area around Lake Shafer. The 30-ft. bridge had collapsed and local residents estimated that several hundred thousand dollars worth of business would go out the window if the road remained closed for any length of time. A crew from Fort Wayne was called at 3:30 p.m., Wednesday, June 26, and by working around the clock, removed the old structure, constructed new abutments and completed the bridge by noon Saturday, June 29, 30 hours ahead of the estimated time. The span of the new bridge was 36', cost $9,344.06. In another instance this crew replaced a 62' steel structure with a 12' wider prestressed concrete structure on U.S. 31 north of Louisville with only 17 hours of road closure time. Prolonged closing would have caused a 19-mile detour and would have inconvenienced the public at the rate of more than $1,000 per hour. On U.S. 6 west of U.S. 33, a 62' steel truss was entirely replaced in 12 hours. On U.S. 41 north of Evansville, a 63' steel truss was replaced and traffic resumed in 8 hours. On U.S. 31 north of Louisville, the crews drove piling and placed supports under a 300' steel bridge so that traffic could use it while it was being repaired. Loss of this bridge, which was damaged by a large truck, would have cost over $1,000,000.

● **HIGHWAY was closed a total of 12 hours for the replacement of old 63-ft. span steel truss with prestressed slabs; bridge was widened from 19 ft. 2 ins. to 30 feet.**

● **BEFORE: This picture shows one of the old and inadequate steel truss bridges, typical of many of the 1,030 of the bridges replaced under the program described in this article.**

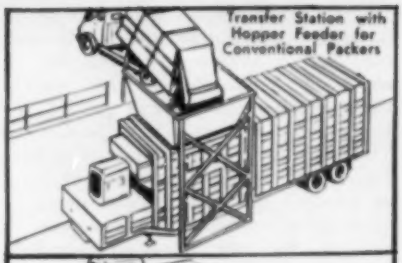
● **AFTER: Bridge has been widened for easy flow of traffic. The 1,030 bridges that were improved represented total expenditures of $3,315,096, or an average cost of $3,218 each.**

Along with the convenience provided to the people of Indiana by the bridge widening crews, the records of the Indiana State Police indicate that at least 100 lives have been saved by removal of the old masonry handrails. Six known collisions with the new type of rails have not resulted in a fatality and the Highway Department has no knowledge of a fatal collision on any of the widened bridges. As efficient as the crews have proven to be, there are still unfortunate incidents that make us wish the job could be done quicker. Several times since the start of the program, a serious mishap has occurred at a narrow structure while widening was in the planning stage.

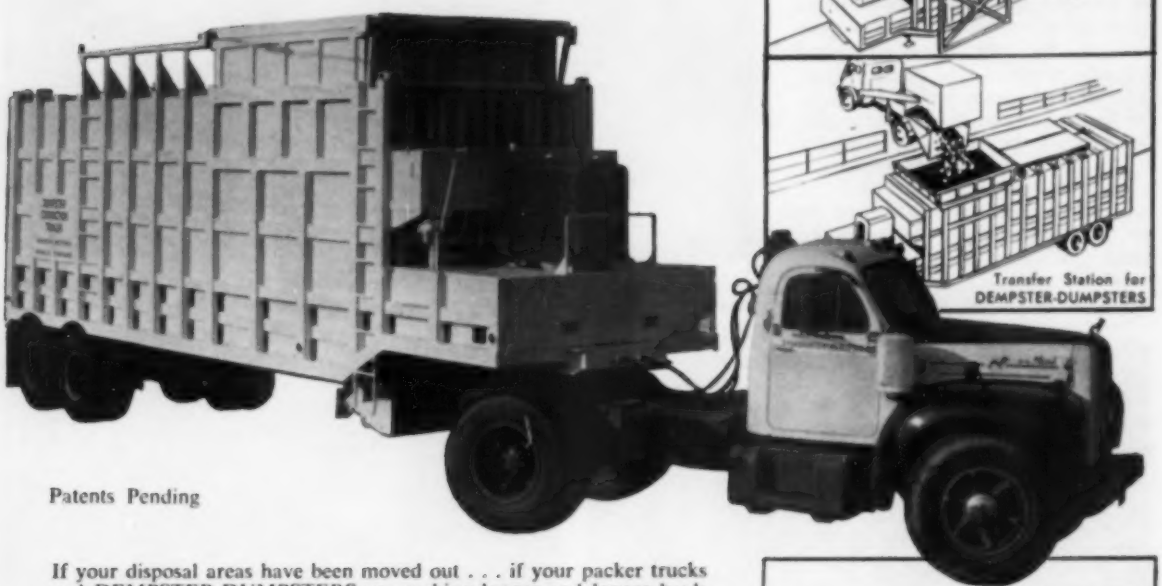
The people of Indiana like the bridge widening program and show their appreciation by holding opening celebrations, praising the crews doing the work, and sometimes actually offering their services and land so that we can do a little better job than planned. Counties are adopting the methods used by the State and during the past year more county bridges were replaced in Indiana than any year in recent history. In fact, everybody that has ever had anything to do with the work has only one comment—"We like it."

New DEMPSTER Compaction Trailer Hauls Up To 200 yds. of Loose Refuse

Giant Hopper Alone Holds Contents of 16 Cu. Yd. Conventional Packer Truck


Transfer Station with Hopper Feeder for Conventional Packers

Transfer Station for DEMPSTER-DUMPSTERS



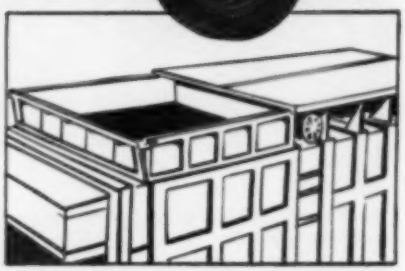
Patents Pending

If your disposal areas have been moved out . . . if your packer trucks and DEMPSTER-DUMPSTERS are making longer and longer hauls . . . you can cut your costs to the bone with the new DEMPSTER Compaction Trailer. This portable transfer station can be placed beneath a ramp or bank in a central location. Then your trucks travel only blocks instead of miles. The big hopper itself holds the contents of a 16-yard packer truck.

One of the several cities using this new trailer stands to save over $32,000 in the first year of operation of only one unit.

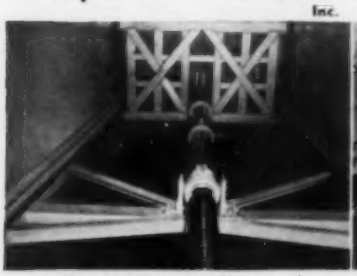
The DEMPSTER Compaction Trailer is all hydraulic, and has its own power plant. Both the 42-yard and 53-yard models deliver 60,000 lbs. hydraulic pressure to the face of the packer plate, enabling users to get (depending on the density of the material) 160 to 200 cu. yds. of loose refuse per trip.

For complete information, send for the free eight-page brochure that describes this new development.



The rolling hopper cover illustrated above increases the capacity of the trailer and prevents refuse scattering.

Dept. PW-7 DEMPSTER BROTHERS, Knoxville 17, Tenn.
Inc.



Inside view of trailer showing telescopic packer head cylinder that delivers pressure of 60,000 pounds.

Typical load of refuse being ejected by the packer plate. No tilting of the trailer is necessary.

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Knoxville 17, Tennessee

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NEWS BULLETINS

AMERICAN PUBLIC WORKS ASSOCIATION, 1313 EAST 60th STREET, CHICAGO 37, ILLINOIS

Prominent Speakers Featured at New York Congress

Chicago, Ill.—Important, current topics of prominent authorities characterize the 1960 Public Works Congress and Equipment Show to be held in New York City, August 14-17.

New York City's Mayor Robert F. Wagner will welcome APWA members and their guests to the "Wonder City" with its endless variety of attractions. The Hon. Robert Moses, longtime construction coordinator for New York City, will deliver the banquet address Wednesday evening, August 17, at the Hotel Astor. In his long career in public service Commissioner Moses has served as head of the New York City and state park systems, Chairman of the Triborough Bridge and Tunnel Authority, Chairman of the New York State Power Authority, Chairman of the Mayor's Slum Clearance Committee, and president of the Jones Beach State Parkway Authority. He is now serving as chairman of the New York World's Fair Commission.

Mr. Moses

The opening address will be given by John Kenneth Galbraith, Professor of Economics, Harvard University. Prof. Galbraith is author of "The Affluent Society," published in 1958, which was on best-seller lists for some thirty weeks—the first serious economic work to achieve such distinction. He is author of several other books on economics and has served on the editorial board of *Fortune* for several years. His articles and reviews are familiar to readers of *The Reporter*, *The Atlantic Monthly* and the *New York Times*.

Many other prominent public works officials from all parts of the U. S. and from Canada will be participating in the technical sessions. Mr. A. Bjorkmen, director of public cleansing, Stockholm, Sweden, will be among the featured guest speakers.

Eugene Maier, director, Department of Public Works, Houston, Texas, will speak on "Transportation—The Key to Urban Development." Stanley Palmer, city engineer, Kansas City, Mo., will cover "Municipal Surveying and Mapping Developments."

Ladis H. Csanyi, Professor in Charge, Bituminous Research Laboratory, Iowa State University, one of the nation's leading authorities on street maintenance research, will talk on "Sealing and Patching Streets and Highways."

These are but a few of the public works topics to be covered during this four-day meeting.

Over 125 manufacturers of public works equipment and supplies have now reserved exhibit space for the Equipment Show in New York City's ultra-modern air conditioned coliseum. A wide diversity of products will be on exhibit.

Preparation for the Annual Meeting are being made by the local committee under the Chairmanship of Paul R. Screvane, Commissioner, Department of Sanitation, New York City.

Everyone who registers early and pays his registration fee in advance will receive, through the courtesy of the New York-New Jersey Chapter of APWA, an attractive fortfolio with his name imprinted on it in gold. An equally attractive portfolio will be presented to the ladies. A gold covered notebook with a ball point pen will be given to advance registrants through the courtesy of the New York local committee. In addition, limited to APWA members registering in advance, there will be a special drawing for a grand prize—an automobile (approximate prize price—$3,500).

For further information about pre-registration, the 1960 Public Works Congress and Equipment Show, or membership in the APWA, write directly to: The American Public Works Association, 1313 East 60th Street, Chicago 37, Illinois.

Washington Chapter Releases Fourth Standardization Report

Chicago, Ill.—The Construction Standardization Committee of the Washington Chapter of APWA has just recently released its Construction Standardization Report No. 4. The Washington Chapter has un-

OFFICERS: Jean L. Vincenz, San Diego, Calif., *President*; Frederick W. Crane, Buffalo, N. Y., *Vice President*. **REGIONAL DIRECTORS:** (term ending 1960) Charles W. Cooke, Hartford, Conn.; R. S. Hopson, Richmond, Va.; H. H. Hester, Fort Worth, Texas; (term ending 1961) Louis H. Moehr, Wyandotte, Mich.; John A. Morin, Oakland, Calif.; Roy W. Morse, Seattle, Wash.; (term ending 1962) Paul R. Screvane, New York, N. Y.; Albert G. Wyler, New Orleans, La.; Edward J. Booth, Bismarck, N. D. *Immediate Past President*, Wm. D. Hurst, Winnipeg, Manitoba. Robert D. Bugher, *Exec. Director*.

dertaken the task of preparing a set of standard specifications for municipal construction work which will be applicable and acceptable to all cities in the State of Washington.

The Committee's fourth report represents another step forward in realizing this goal. The committee reports that the work of some of the subcommittees has progressed to the point where drafts are almost ready for submission to the various cities for the first review. To insure the very best and most widely acceptable specifications possible, an elaborate system of checks and reviews has been established so that before becoming final every section of the specifications will be subject to the review and criticism of every city and every individual in the State who may have any possible interest in, or knowledge of the matter. This will, of course, greatly increase the time and labor required for completion, but such a procedure has been considered necessary by the committee to insure that the end product will provide the ultimate in usefulness. The committee estimates that completion of the task may take approximately another two years. In the interim, sections complete in themselves will be issued for use.

The basic purpose of the program is to obtain better workmanship in municipal construction and to effect greater economy in the use of the tax dollar.

The Committee's activities are presently concentrated on the preparation of municipal construction specifications which, as far as general form is concerned, will be comparable to those of the Washington State Highway Department. These specifications will contain requirements for the construction of streets and highways, storm and sanitary sewers, water distribution, and related work, and will be further broken down to cover every possible phase of the construction operation. In conjunction with the specifications, standard designs for such items as manholes, castings, catch basins, curbs and gutters are being prepared.

The standardization program of the Washington Chapter has been endorsed by the Washington State Good Roads Association, the Washington State Highway Users Association, the Washington City Manager's Association and the Association of Washington Cities.

Activated in 1956, the Committee is the direct result of a panel presentation at the first annual meeting of the Washington State Chapter of APWA. This presentation outlined the various construction problems and the higher costs evidenced in many cities and towns of the State, due to the fact that there was a multiplicity of designs and procedural requirements in various phases of construction, which if carefully analyzed, could be standardized to the benefit of all. The fundamental principle of municipal construction standardization was established at this time as being one of effecting greater economy so that the tax dollar may be more effectively used. With this basic principle in mind, the Committee proceeded with this task. Subsequent Committee meetings and discussions with municipal engineers throughout the State confirmed the extreme need for municipal construction standardization.

R. G. Anderson, Chief, Construction Division, Department of Public Works, Tacoma, Wash., is presently chairman of the Chapter's executive committee.

This work of the Washington Chapter is an excellent illustration

"RAMFLEX RUBBER ROADS

don't SPLIT or BREAK
even after our SEVERE weather",

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Supt. of Highways,
Cheektowaga, N. Y.

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"In our 200 miles of roads to be maintained we have found Ramflex has definite advantages. It imparts rubberiness to asphalt so that our roads resist splitting in cold weather. Similarly, it makes asphalt less brittle which holds the aggregate firmly in place—thus reducing breaking. Asphalt containing Ramflex does not emulsify and retains its adhesion to the base—moreover, no shoving has been noticed even under heavy traffic conditions." All this adds up to better paving at low cost and practically no maintenance. And—Ramflex Rubber Roads are especially appealling to motoring taxpayers because "when rubber rolls on a rubber road . . . everybody "SAVES".

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4. LARGEST LOWEST HOPPER—Big 1½ cubic yard, 74 inch wide hopper, plus low loading height.

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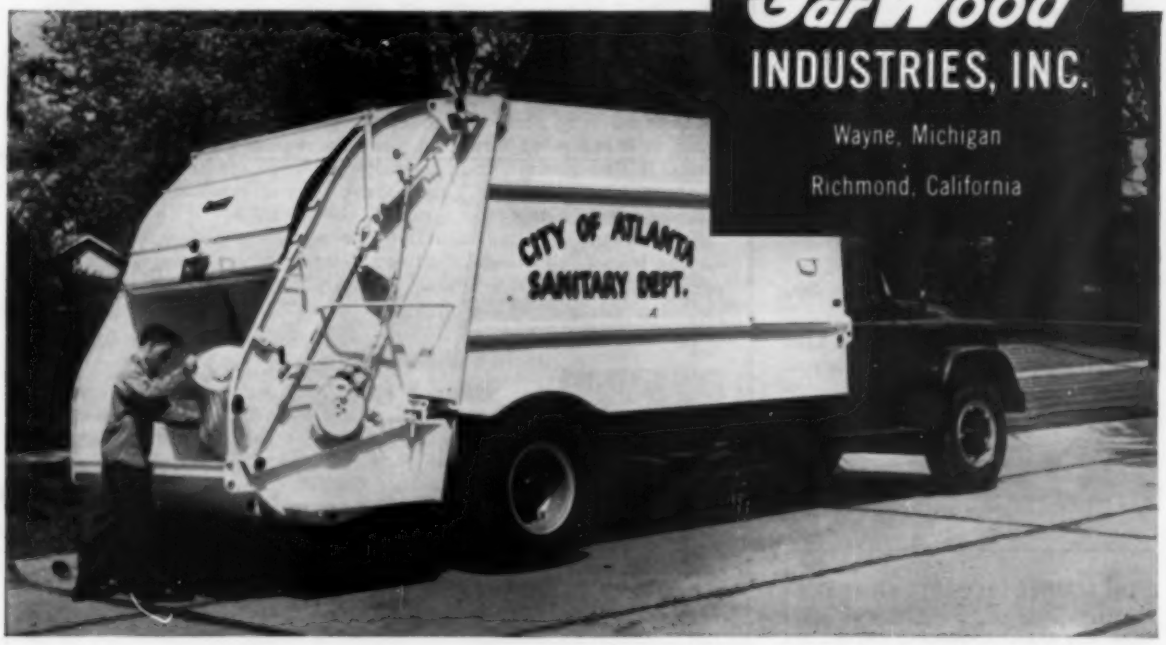
6. GREATEST ECONOMY—Biggest hopper and fastest packing cycle cut fuel costs and equipment wear.

Find out more about the efficiency-engineered, BIG SIX performance of the Load-Packer 600 from your Gar Wood - St. Paul truck equipment distributor. Ask him to show you the colorful, sound film, "The BIG-6 Story" soon.



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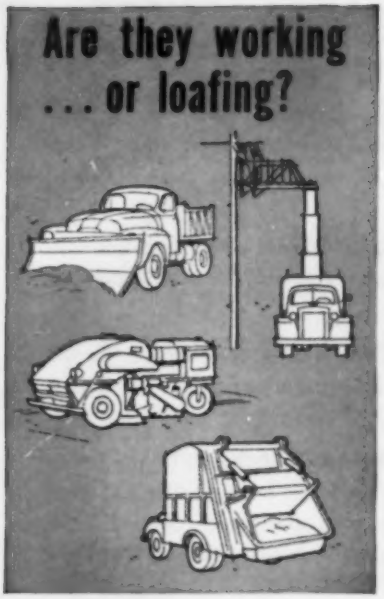

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Guard against costly inactivity! Install tamperproof Servis Recorders on street cleaners, dump trucks, front-end loaders and municipal and county fleets.

A clock mechanism turns a chart on which is accurately recorded the length of all stops and delays as well as the working time of all equipment. Engine idling time, too, can be recorded distinctly so that fuel economies can be effected.

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of important advancements being made in the public works field by Chapters of the American Public Works Association.

Spring Meeting of New York-New Jersey Metropolitan Chapter, APWA

Spring rain clouds parted and the sun shone brightly on the trim new garage of the Village of Hempstead, New York as the New York-New Jersey Metropolitan Chapter of APWA convened there for its Spring Meeting on May 12, 1960. The program included a luncheon with a welcoming address by Mayor W. O. Gulde of Hempstead, followed by a paper on mosquito control by LeRoy Kinsey, Nassau County Deputy Commissioner of Public Works, and a paper on asphalt production by Jerry J. Pike, Esso-Humble Corporation. In addition to an excellent equipment show on the Village garage grounds, inspection trips were conducted by bus to the Nassau County Sewage Treatment Plant; a County Marina; the Marine Building for Mosquito Control and the Police Department Marine Division.

The evening program included dinner at Nassau County Salisburg Park followed by remarks from Meeting Chairman F. R. Rundle, Engineer and Superintendent of Public Works, Village of Hempstead and an address by United States Congressman Frank J. Becker.

The Consulting Engineer's Place in APWA

The professional engineer, serving as a consultant to various governmental bodies and especially to fast-growing metropolitan areas and municipalities, is hard pressed to keep fully abreast of the technological advances of the art he practices and of the day-to-day developments throughout the length and breadth of this great land. It is mandatory that he utilize fully the concise summaries and conclusions presented in such publications as PUBLIC WORKS Magazine, the *APWA News-Letter*, and the like.

Certainly if he is engaged in one or several of the pressing problems of modern living, such as are found in the fields of traffic, parking, refuse collection and disposal, sewerage and sewage treatment, water supply, street paving, airport development and the newer field of air pollution control, he cannot serve his clients properly unless he keeps pace with the advances of his specialty and knows how to apply the best possible solution dictated by the local conditions prevailing.

Membership in service and technical associations—one of my earliest affiliations was the American Society for Municipal Improvements, a predecessor of APWA—are the tools he has to use to keep alert to the very rapidly changing conditions. Attendance at sectional and local area meetings and APWA's Annual Public Works Congress & Equipment Show, with active participation in committee work and discussions, broadens one's knowledge of practical solutions to localized problems, and further, it is good business. Personal contacts made at such assemblies are invaluable from a long range business engagement viewpoint. Only people can give you the opportunity to demonstrate your special knowledge of the problem confronting them. Black & Veatch have a long established policy of attending such meetings.

So it should be fundamental to your success and to the proper service to our fellow men, that we maintain active membership plus participation in APWA affairs. Without the data thus gleaned, we cannot properly serve our clients.

E. L. Filby

Mr. Filby

Ellsworth Filby, civil and sanitary engineer, a partner of Black and Veatch Consulting Engineers, Kansas City, Mo., has been a member of the American Public Works Association since 1944. A graduate of Cornell University, Mr. Filby has held such positions as Chief Engineer, Florida State Board of Health, and Sanitary Engineer, South Carolina State Board of Health. He has been with Black and Veatch since 1951.

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benefit with DAYBROOK "POWER PACKING"

Daybrook Power Packers are being operated in leading cities from coast-to-coast. Their reports of outstanding performance of Power Packers have been based on field operation . . . testimony of the convincing job Power Packers are doing for others and can do for you, too!

More and more communities are turning to Daybrook Power Packers because of their proven record of increased collection efficiency. Continuous loading, pre-crushing of all material before it enters the body, and then compaction into the body results in more collections per load and better compaction of the load. Other outstanding advantages include far safer operation, lower maintenance and lower operating costs.

See the actual proof of Daybrook Power Packing.

Let us plan a Power Packer demonstration in your city on a route of your choice. You name the date . . . Daybrook will stand by the results!

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Let us show the 20-minute color movie, "Power Packing", in your office or to a group of your officials.

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Or, let us send you a copy of the Daybrook Power Packer brochure, "More Efficient Refuse Collection".

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Daybrook—manufacturer of a full line of truck equipment for cities, counties, state and federal governments—

- *Aluminum and Steel* **DUMP BODIES**
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Daybrook Power Packers are now available in 16, 18, and 20 cubic yard capacities, and can be equipped with Sani-Tainer refuse container method for collecting commercial and industrial refuse. Sani-Tainers are available in 1, 2, and 3 cubic yard capacities.

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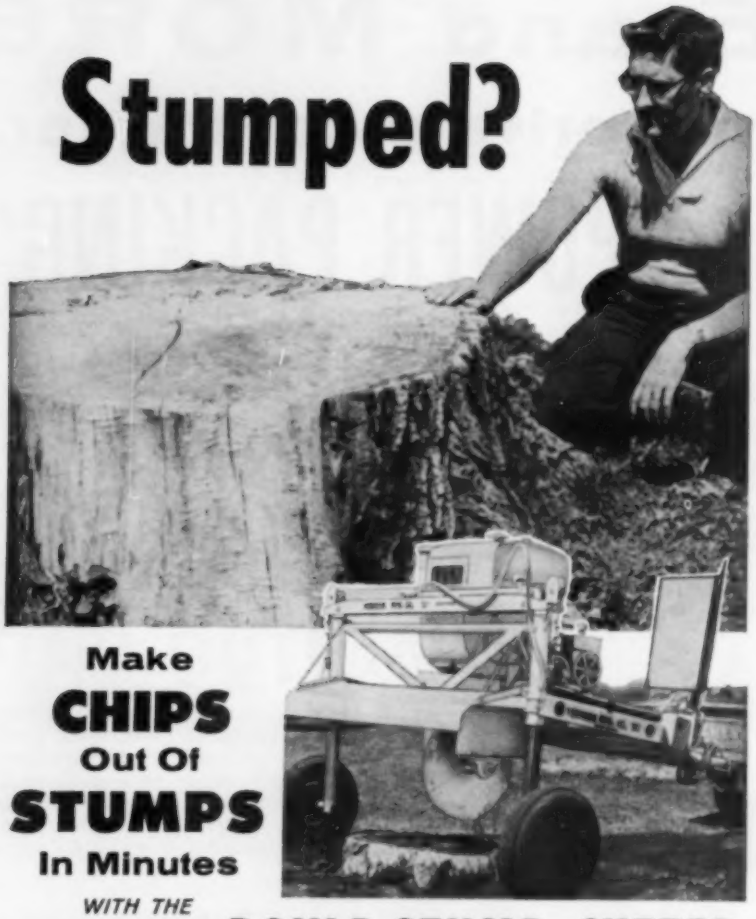

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You needn't be stumped any longer when you're faced with the job of removing unsightly tree stumps. One machine—the original Vermeer POW-R-STUMP CUTTER—can solve your problems in less time, with less work and at lower cost than you ever thought possible. Save hundreds of man hours and thousands of dollars annually. A real profit maker for tree service firms. The STUMP CUTTER tears into stumps of any size, and just minutes later nothing remains but a hole 10" deep and a pile of chips. One-man operated, the Vermeer POW-R-STUMP CUTTER allows close quarter cutting to sidewalks, buildings, curbs and driveways without damage. Tested, proved and approved in municipalities, parks, golf courses and cemeteries all over the country. Hundreds in use. Ruggedly built for years of trouble-free service, the POW-R-STUMP CUTTER is a real time saver . . . a real labor saver! There's only one POW-R-STUMP CUTTER . . . ask for a demonstration. *(Registered under U.S. Patent No. 2912022)*

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Send complete descriptive literature and prices on your POW-R-STUMP CUTTER to:

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An outstanding example of long and loyal public service was brought to the attention of the Chapter when Louis Lembo, Foreman in the Street Department of the Village of Ridgewood, New Jersey, was honored on the eve of his retirement after 52 years of service to the village.

Six New Firms Become Sustaining Members of APWA

Chicago, Ill.—The American Public Works Association is pleased to announce that six new firms have recently joined the ranks of APWA Sustaining Members.

They are the Industrial Division of The Harnischfeger Corp., Milwaukee, Wis., Motorola Communications and Electronics, Inc., Chicago, Ill. The Lock Joint Pipe Co., East Orange, N. J., The Tarrant Manufacturing Co., Saratoga Springs, New York, Morton Salt Company, Chicago, Illinois, and Truck Equipment Corporation, Richmond, Va.

The APWA has established a special membership open to the manufacturers of public works equipment and supplies, whereby they can make and maintain direct contact with officials and practices in the public works field. The manufacturer has played an important role in the public works field through improved products that are constantly being developed to increase the efficiency of governmental operations.

• • •

Parking Meter Attendants

Improved motorists understanding of the parking regulations and their purposes will be the first assignment of the new 100 women parking meter attendant force of New York City's Traffic Department. The women, who completed their two-week training courses on May 31st, during their first week of duty, sought to increase understanding of the laws by distributing pamphlets to motorists containing excerpts from the New York City traffic regulations specifically pertaining to parking at street and off-street metered spaces. Thereafter, five-member meter-attendant teams, patrolling on rotating shifts, 8 A.M. to 10 P.M. seven days per week, issue summonses to cars parked illegally at meters in the 210 business and commercial districts of the City.

The pamphlet entitled "Assure your parking place," advises motorists that by voluntarily observing "time limitations," established by

parking meters, they protect their own right to park, when they need it and will avoid summonses. Parking meters are described as a means of giving the maximum number of people a chance to park in areas where curb space is at a premium. During 1959 over 75,000,000 motorists used the 52,000 metered-parking spaces on New York City's streets.

The two major points made in the pamphlets are: 1) A motorist must deposit a coin immediately upon parking his vehicle unless he chooses to use any unexpired time left by a previous parker; and 2) A motorist may not park at any curb meter for a consecutive period of time longer than that permitted in the meter zone, nor deposit any additional coins to extend the time.

The women will be attired in Air Force blue uniforms with fitted jackets, skirts and hats, a navy scarf, tailored white shirt and black pumps.

• • •

Snow and Ice Control in Wayne Co., Mich.

The snowfall for the 1958-1959 winter in Wayne Co., Mich., was 31 inches or about 80 percent of normal. The Highway Maintenance Division of the Board of County Road Commissioners operated 110 snow plows and 14 motor patrol graders from its various yards, according to the annual report from which these data are taken. Predetermined routes were followed by plow drivers so that state trunklines and County primary roads received attention first; local roads next; and residential streets last. Many light snowfalls create a serious problem, as heavy highway traffic immediately packs down light snow and an icy condition results. Salt is applied promptly over the surface of the highway by trucks equipped with mechanical spreaders. Approximately 75,693 tons of salt were used during the winter of 1958-59. It was stockpiled in 15 strategic locations throughout the county to lessen the distance to critical areas.

Snow fences were used on county roads and state trunklines where necessary. They were erected on private property, 50 to 100 feet off the right-of-way, in open areas where permission was received from property owners. Snow fences are erected during the month of November before the first snowfall and are removed early enough in the spring so that property owners are not inconvenienced.

BRUSH DISPOSAL CREWS OPERATE FULL TIME WITH THE TROUBLE-FREE

FITCHBURG CHIPPER

CITY

This low-maintenance Fitchburg Chipper is disposing of brush in the City of Holland, Michigan.

PUBLIC WORKS DEPT.

"Our Fitchburg Chipper consolidates the bulk, thereby lessening dumping operations. It requires minimum maintenance and manpower."
Dept. of Public Works
State of Rhode Island

TREE COMPANY

"We have never had one (Fitchburg Chipper) wear out or give excessive trouble." Chipper still operating after 9 years.
Davey Tree Surgery Co. Ltd.
San Francisco, Calif.

UTILITY

"Our men have been particularly pleased with their Fitchburg Chippers . . . they are rugged and reliable."
Rockland Light & Power Company
Nyack, New York

When crews go out to trim trees, it's costly to have machine breakdown. That's why foresters, park superintendents, line clearing supervisors, and tree companies prefer the Fitchburg Chipper. This well-engineered brush chipper is designed for busy, trouble-free service, no down-time.

The rugged Fitchburg Chipper requires little upkeep, and has low maintenance cost. It's economical to operate. And crews like the exclusive spring-activated feed plate which adjusts itself automatically to any size brush up to its rated capacity. This patented feed-plate provides protection from damage from foreign materials, makes for greater crew safety.

The Fitchburg Chipper is engineered to work fast, safely, and to be always "ready to go." It's the chipper which won't slow down your crews, lets you plan their work intelligently—saves you time and money.

Please send in the coupon for more information, and for copies of articles on chipping which appeared recently in leading publications. These feature articles describe five methods of brush disposal and ten new ways to utilize "by-product" chips. Send for your copies, they are well worthwhile.

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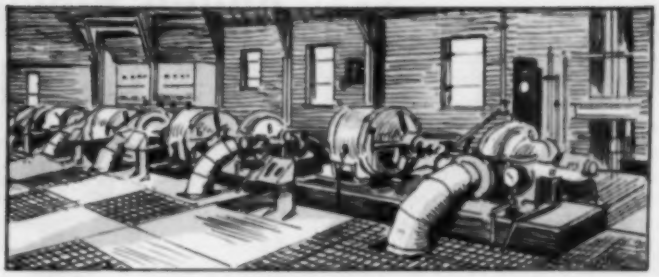


Prepared by **ALVIN R. JACOBSON, Ph. D.**

Associate Professor and Head, Division of Sanitary Science, Columbia University School of Public Health

Demineralization At Coalinga

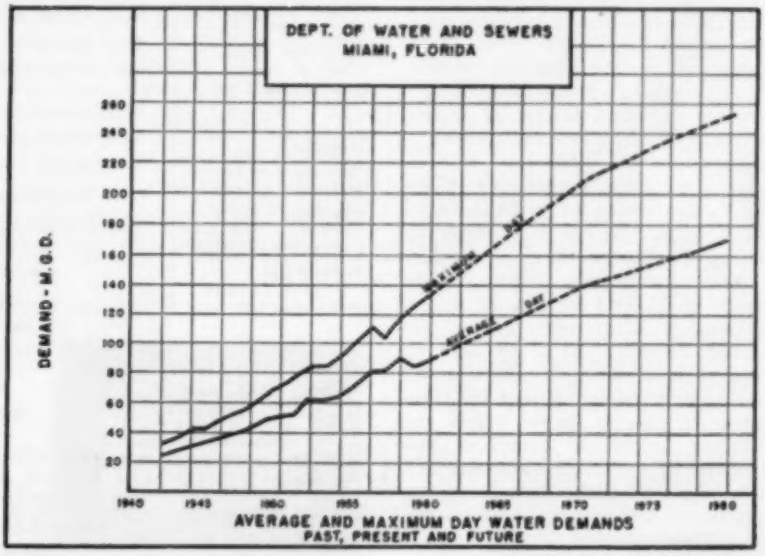
Coalinga, Calif., with a population of approximately 6,300, has been demineralizing its hard-water supply by means of a process developed by Ionics, Inc. The process of electrodialysis employs a unique application of ion-exchange resins for removing minerals from water. The equipment used in a demineralization plant includes: One or more demineralization units, electrical equipment, pumps, chemical-feed equipment, filters and hydraulic and electrical controls. A demineralizer unit is known as a "stack" which may be thought of as a many-layered sandwich. Each pair of one type of layer represents two different kinds of ion-exchange membrane sheets that are permeable on a selective basis (permselective)—that is, permeable to charged ions under certain conditions and impermeable to water. One membrane is permeable to positive ions (cations); the other is permeable to negative ions (anions). The other types of layers are spacers with channels cut in them; one spacer for water being demineralized, the other space for waste water. When a direct current flows through the stack from cathode to anode, ions are attracted toward their opposite pole, pass through the membrane selective for them, into the adjacent waste channel, and are concentrated in this channel. The average removal of minerals through the four stacks at the Coalinga plant is about 83 percent. The one serious operating difficulty, short filter life and clogging of the stacks, apparently resulted from providing feedwater for the plant from a relatively inactive water main containing suspended matter. The water produced has been accepted by the citizens and as far as they are concerned, the plant is a success. The supply being replaced was extremely costly to the individual—a cent a gallon.

"Domestic Water Supply Demineralization At Coalinga. By Edmund S. Cory, Henry J. Ongerth, and Reginald O. Phelps. *Journal A.W.W.A.*, May, 1960.

Miami's Master Water Plan

Metropolitan Miami is experiencing a rapid rate of population growth which is expected to continue for many years. The Department of Water and Sewers is a semi-autonomous public agency operated by the Water and Sewer Board, with authority to issue revenue bonds to finance construction of facilities. Planning for future water demands is an essential part of this Department's program. Two large water treatment plants, distribution pumping stations and storage reservoirs and other waterworks facilities serve a present permanent population of approximately 560,000 in metropolitan Miami. The Department maintains a full time engineering planning section. Special emphasis is placed on stage development of water supply facilities because of rapid growth. The most recent planning completed in 1959 was divided into three basic parts: I. "Population Study and Water Requirements"; II. Supply and "Treatment"; and III. "Distribution System." A master plan was prepared for improvement of existing distribution facilities and for development of new distribution facilities. A schedule for development of pumping, storage and transmission facilities was also prepared. The estimated total cost based on present day prices is $25 million.

"Miami's Master Water Plan for Current and Future Water Needs." By C. F. Wertz, Director, Garrett Sloan, Chief Engr., and David B.



Courtesy Water and Sewage Works

Uses hundreds of

IOWA FIRE HYDRANTS and GATE VALVES

IOWA Fire Hydrants and Gate Valves form an important part of the more than $4,000,000 investment in water and sewage facilities for a completely new "City Within a City", a Perini-Westward development, entirely within the city limits of West Palm Beach, Florida. One of the owners is Louis R. Perini, Chairman of the Board of the Milwaukee Braves and President of Perini Corporation.

The eye-catching central pavilion dominates a 12-acre exhibit in the nine-square-mile area where more than 40,000 people are expected to live. Hundreds of Iowa valves and hydrants were installed to control the flow of water and provide fire protection throughout the 100 miles of cast iron water mains serving this $450,000,000 development.

The IOWA products were selected because of their proved long life and easy maintenance... plus the assurance that parts and replacements will be always available. Such longtime future service is an important part of every purchase of IOWA products.

One of hundreds of IOWA fire hydrants and gate valves being installed at Perini-Westward development within the city limits of West Palm Beach, Fla.

Let us send you details on IOWA'S *complete line of valves and hydrants*

IOWA VALVE COMPANY

Oskaloosa, Iowa

A subsidiary of James B. Clow & Sons, Inc.

Preston, Water Production Supt., Dept. of Water and Sewers, Miami, Fla. *Water & Sewage Works*, May, 1960.

Some Practical Ideas

In this article the author states that if a water works man has the ability to work with tools and has some curiosity and resourcefulness he can come up with many new ideas and relatively inexpensive gadgets which may be of considerable help in improvement of water works maintenance. The author describes several of these devices, together with photos, which may be used in any system, large or small. The devices described include a transistor-equipped "midget leak detector"; a periscopic flash light for determining whether a hydrant is drained or the valve is leaking; a mechanical device for lifting manhole covers; a hydraulic pipe cutter that fits into a narrow trench; metal barricades; a simple meter repair bench; a truck-mounted hydraulic hoist capable of lifting as much as 1,000 pounds; a good diaphragm-type trench pump; a small pump mounted on a car or truck engine; and several other devices which are relatively inexpensive to make and can be very useful in any water works maintenance program.

"Some Practical Ideas on Water Distribution Maintenance That Can Be Used in Any System, Large or Small." By H. W. Niemeyer, Supt. of Distribution, Indianapolis Water Co. *The American City*, May, 1960.

Milwaukee's Water Plan

At the present time Milwaukee has underway a $35 million water works improvement program. The largest segment of this program, the South Side Water Works, is designed to augment the existing intake, purification and base-load pumping stations located on the North side. The new South Side plant is to consist of a new intake, raw water pumping station, raw water conduit, purification plant, pumping station and feeder mains. The plant will have a rated capacity of 100 mgd and is scheduled for completion in 1962. In the meantime, the growing load must be carried by means of the existing plant facilities, plus such improvements and operational changes as can be devised. These improvements consist of booster stations, feeder mains and a Control Center. The Control Center consists of three different systems: 1) A data-logging system; 2) an internal telephone system; and 3) radio communication to mobile equipment. Under the heading of operational changes, three categories might be mentioned. The first is the operation of the entire water works as a more tightly knit system, rather than as individual facilities operating on a cooperative but not centrally directed basis. The second involves the changing and redistricting of some of the booster districts. The third procedure is one which must be continued for at least two more years—sprinkling restrictions.

"Making Milwaukee's System Work 'Harder' to Meet Metro Demands." By Arthur Rynders, Superintendent of Water Works, Milwaukee, Wisc. *Water Works Engineering*, May, 1960.

Study of Ground Water Quality

An excellent study by the Suffolk County Dept. of Health of the present extent of contamination of ground water in Suffolk County, Long Island, New York, is partially abstracted and quoted in this article to illustrate the methods of making

Horsepower

Substitution of mechanical horsepower for human muscle-power, is largely responsible for the amazing expansion of the U. S. economy until it leads the world with the highest standard of living. Economists call it the American industrial revolution.

M & H is truly a product of the American industrial revolution. The Company's real growth and development started in 1932, when M & H was reorganized and joined the mechanical horsepower movement. About that time the electric motor was being introduced as a source of industrial power. Realizing this trend, M & H Management redesigned its products and modernized its production equipment.

Slow, tedious, hand-operated manufacturing processes were discarded. Sand equipment, cranes, machine tools, every M & H wheel was soon being turned by electric power.

Rapidly the Company's volume of sales and production began to grow. With the years, it gathered momentum because the M & H plant modernization kept up with new developments and never stopped. The Company's annual sales volume now makes it one of the most successful valve and hydrant producers in the country – thoroughly equipped to provide highest quality products for water works improvements.

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At City of Attleboro, Mass., operator checks level on six different wells — miles apart — by simply flipping selector switch under Teletax Indicating Receiver. Telemetered information helps him even out well-loads — prevents "sapping" a well prematurely. *Consulting Engineer:* Julian White, Boston.

at Attleboro, Massachusetts

Foxboro Telemetering puts this man at six different wells... without ever leaving the panel

Well level, flow rate, "is the pump on or off" — that's the kind of information Foxboro Teletax* Telemetering delivers to the central pumping station at Attleboro, Mass. And from wells up to four miles away.

And it's all automatic, too. If the clear well needs increased supply, Foxboro Teletax sends a "start" signal to additional pumps until the demand is met. Pumps are added in pre-determined sequence to assure that all wells contribute evenly — instead of one or two carrying the whole load.

Foxboro Teletax Telemetering can save your community money, and your personnel hundreds of miles of legwork. And help make your system operate more efficiently, too. Ask your local Foxboro Field Engineer about it. Or write for Bulletin 17-11. The Foxboro Company, 267 Norfolk St., Foxboro, Mass.

*Reg. U. S. Pat. Off.

At well-head, two Foxboro Teletax transmitters are used. Left instrument transmits well level; transmitter at right signals rate of flow from well to reservoir. Other signals report on pump status — permit turning it on or off from central station.

FOXBORO

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TELETAX TELEMETERING

the study and to describe the conditions that were found. The sources of pollution include industrial plants discharging wastes containing nitric acid, hexavalent chromium, cadmium, nickel, cyanide, and synthetic detergents. It is estimated that laundries and laundromats use about 4 mg of water and 40,000 lbs. of washing compounds per month. The wastes from these laundry facilities contain approximately 250 mg/L of synthetic detergent based on the assumption that 25 percent of the washing compounds is composed of synthetic detergent. It is also estimated that 95 percent of the domestic and sanitary sewage in the county is discharged through subsurface leaching systems into the ground water. In addition, there are scavenger disposal sites throughout the county where over 100,000 gpd of cesspool and other liquid waste are discharged. In addition to domestic and industrial wells being contaminated with cadmium, chromium, zinc and syndets, these wells have indicated the presence of decomposing organic substances, particularly large amounts of free ammonia, indicating in many cases the freshness of the sewage and the close proximity of the discharge. About 70 percent of the population obtains its water from some 90 communal or public water supply systems, the remainder of the people being served by approximately 150,000 individual wells, some located on lots of 4,000 to 7,500 sq. ft. in area, this space being shared with individual sewage disposal systems. Syndets have varied from 0.3 to 1.2 mg/L in 7 of the public water supplies. About 35 per cent of the individual wells sampled were found to contain syndets indicating that about 17,000 wells contain synthetic detergents in the county, in amounts up to 4.5 mg/L. The syndet problem is one which becomes more severe with the passage of time as shown by the results of this study. In addition, bacteriological analyses have shown coliform organisms in concentrations varying from an MPN of 2.2 to more than 2,400 per 100 ml. The authors conclude with a plea for additional research in order that solutions may be forthcoming to some of these problems.

"A Study of Ground Water Quality and Contamination Sources." PUBLIC WORKS, June, 1960.

San Antonio's Water Program

A vast improvement program, highlighted by construction of three new electrically-operated primary pumping stations, new elevated and ground storage tanks and 130 miles of mains, is nearing completion to serve a population of over 550,000. San Antonio's only source of water at present is the Edwards Limestone formation which may be inadequate in 3 to 5 years according to engineering studies. The largest of the three new pumping stations, costing $1,700,000, is located atop the city's flood control reservoir known as Olmos Basin and is served by four artesian wells. The station has four high service pumps with a rated capacity of 60 mgd. Another one of the new pumping stations is located in the downtown high value district and has four new electrically-driven pumps with a combined rated capacity of 52 mgd. The third new major pumping station is located on the west side and draws its water from three wells; its four high service pumps have a combined capacity of 33 mgd. These three stations have ground storage tanks of 5 million, 800,000 and 5 million gallons capacity, respectively. The new electric plant being designed will be

ATLANTA *chose* STEEL PIPE

. . . every length was hydrostatically tested in the shop to AWWA standards!

To provide for industrial and residential expansion in South Fulton County, Atlanta Water Works installed an additional 8,200 ft. of steel pipe along Fairburn Road. This new line incudes 2,916 ft. of 36 in. pipe and 6,200 ft. of 30 in. pipe, all with 5/16 in. wall thickness and in 50 ft. lengths.

STRENGTH
TIGHTNESS
ELASTICITY
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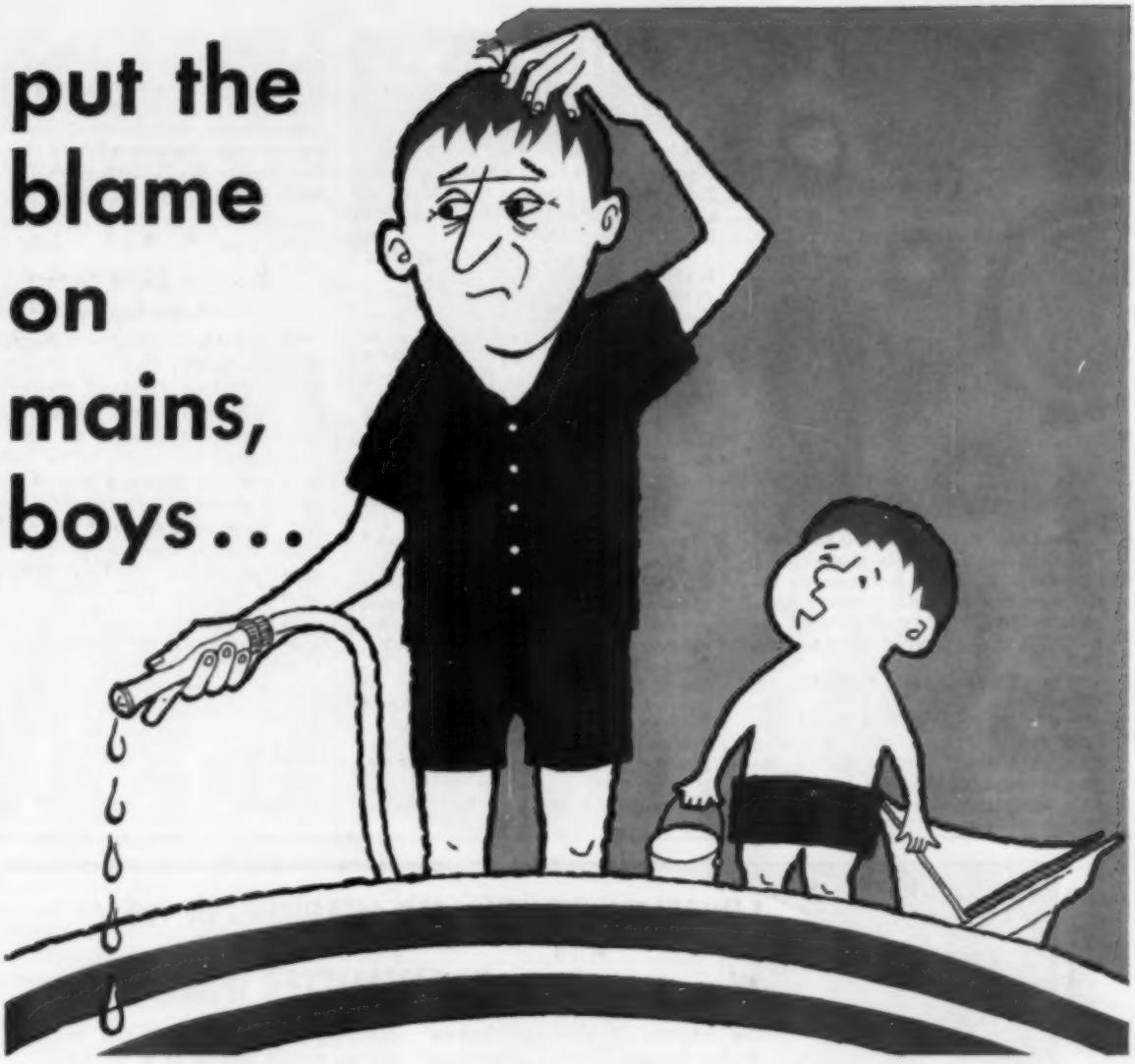
. . . these are inherent qualities of fabricated *steel* pipe. Compare *steel* pipe with other types . . . you'll see why "wherever water flows, steel pipes it best." You can always specify *steel* pipe with confidence.

For your copy of the latest steel pipe brochure, write—

STEEL PLATE FABRICATORS ASSOCIATION
105 West Madison Street • Chicago 2, Illinois

put the blame on mains, boys...



Are you hearing customer complaints about low water pressure? After the spring's heavy rains which filled reservoirs to the brim all over the country, *there should be no water shortage.* The problem probably rests underground . . . mains and distribution grids choked by pressure-killing tuberculation and corrosion.

There's one sure cure for your pressure problem . . . the Centriline Process. Centrilining permanently increases carrying capacities in all sizes of pipe by eliminating tuberculation and corrosion forever. After loose scale and tubercules are removed from the pipe, the Centriline machine applies a smooth, uniform coating of cement-mortar to the pipe wall by centrifugal force. Fast and economical, Centrilining is accomplished with a minimum of interruption to surface traffic, since the pipes are lined in place and excavations are not required at laterals and services.

With the introduction of the new, small diameter Centriline machine, you can permanently protect all water lines from 4 to 144 inches in diameter. Send today for our new brochure which fully describes the Centriline Process.

CENTRILINE CORPORATION

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Branch Offices in Principal Cities of the United States, Canada and Latin America.

operated by remote control with a capacity of 30 mgd at a cost of $725,000. The three new 1.5 mg elevated storage tanks being erected are of the radial-cone bottom type and will cost $270,000 each. A total of 132 miles of distribution mains are to be installed ranging in size from 36 inches down to 12 inches, with some 6- and 8-inch. Studies are being completed toward the development of a master plan for metropolitan San Antonio.

"San Antonio Is Catching Up On Overdue Water Works Improvements." By R. A. Thompson, Jr., General Manager, City Water Board, San Antonio, Texas. PUBLIC WORKS, June, 1960.

Other Articles

"Push Button **Chemical Feeders.**" Philadelphia's Torresdale plant utilizes the maximum available pneumatic instrumentation to permit virtually complete automation. A staff pictorial report. Water & Sewage Works, May, 1960.

"The **Metropolitan Explosion** is Changing the Face of America." Planning for America's metropolitan future is a task requiring much dedicated thought and extended action on the part of community leaders and individuals of the urban community. By George H. Deming. Director, Conference on Metropolitan Area Problems; Director, Metropolitan Areas Program, Institute of Public Administration. Water Works Engineering, May, 1960.

"Lime Recovery Pays in Miami." First plant pays for itself in five years. By C. F. Wertz, Director, Dept. of Water and Sewers, Miami, Florida. The American City, May, 1960.

"Opportunity and Savings in **Spotting Leakages** in Rural Nets." Opportunite et Economie de la Recherche des Fuites dans les Reseaux Ruraux. Par M. Geinger, Directeur d' Exploitation a la Societe Nationale des Distributions d'Eau. La Technique de l'Eau, 15 Avril, 1960.

"Design and Construction of **Small Dams.**" For flood prevention, soil erosion reduction, etc. By Carl A. Elsea, Hydraulic Engineer, Soil Conservation Service, Sioux City, Iowa. PUBLIC WORKS, June, 1960.

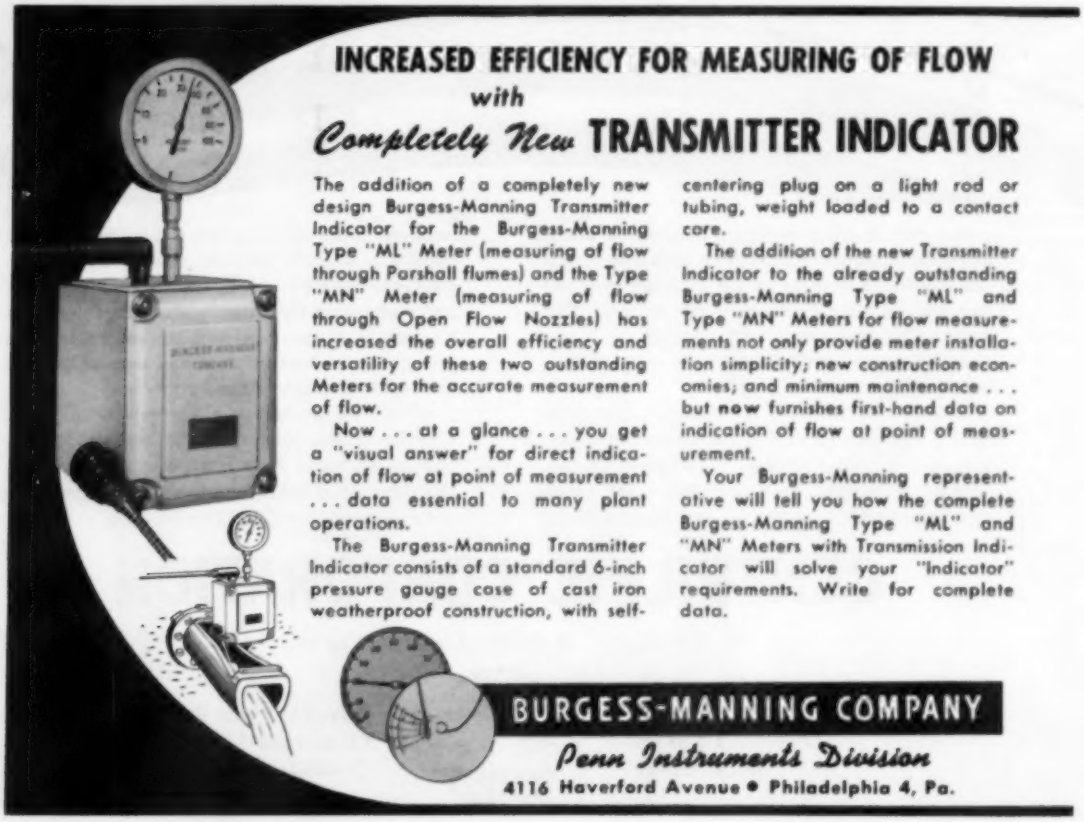
"Review of **Desalinization** Processes." A panel discussion presented on Oct. 21, 1959, at the joint meeting of the Alabama, Mississippi and Southwest sections, New Orleans, La. "Recent Developments." By Joseph J. Strobel, Chief, Processes Dvelopment Div., Office of Saline Water, U. S. Dept of the Interior, Washington, D. C. "Membrane Processes." By Ernest H. Sieveka, Process Engineer, Office of Saline Water, U.S., Dept. of the Interior, Washington, D.C., "Freezing Processes." By Dewey J. Sandell, Jr., Director of Research, Carrier Corp., Syracuse, N. Y. "Distillation Processes." By David M. Bradt, Eng. Mgr., The J. G. White Eng. Corp, New York, N. Y. "Solar Distillation." By O. G. Lof, Research Assoc., Resources for the Future, Washington, D. C. Journal A.W.W.A., May, 1960.

• • •

Reservoir Roofs Protect Water Supply

To provide maximum safeguards to public health East Bay Municipal Utility District, Oakland, California, has embarked upon an extensive construction campaign to roof all distribution reservoirs in its system with creosote pressure treated wood as the principal construction material. Present plans call for roofing eight existing reservoirs and five new reservoirs totaling 3,200,000 square feet, by 1967.

In its statement of policy covering open reservoirs, the district has determined that such roofs afford protection against the following types of contamination which seriously affect water quality: 1) Bird and wind-blown contamination which may create serious public health problems in the water; 2) algae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growths which develop readily in open reservoirs, producing undesirable tastes and odors; 3) Chironomid larvae development which is extremely detrimental to public relations; 4) surreptitious bathing and throwing objects in reservoirs, activities which are difficult to control in open reservoirs; and 5) sabotage and fall-out of nuclear fission products, a remote possibility, but with a potential in this atomic age.

After research and operating experience over a long period of time the structures design section, headed by William W. Ramsay, supervising civil engineer, has determined that pressure treated wood will provide long life with low initial cost. Recent inspection of two roofed reservoirs with up to 27 years service show no failure or damage due to wood-destroying fungus or termites to creosoted wooden members. The Dingee Reservoir was roofed in 1938 and is as sound as the day it was covered. The Thirty-Ninth Avenue Reservoir was roofed in 1933, using creosoted joists and untreated redwood decking. Due to failure of the redwood decking, this roof will be rebuilt using original treated joists in the new modified structure.

Maloney Reservoir, located near Pinole, California was one of the first of the five new reservoirs to be roofed. Within 20 working days all creosote pressure-treated members were put into place. The roof area is 139,000 square feet and the roof is supported by 8-inch cement mortar coated pipe columns. Glued laminated girders are up to 72 feet long, and are placed on 24 foot centers. Joists are covered with 2" diagonal sheathing. Girders, as well as joists and sheathing, are Douglas Fir pressure treated in accordance with American Wood Preservers Association Specifications with No. 1 coal tar creosote to a minimum net retention of 8 lbs. and 10 lbs. respectively per cubic foot of wood, by the empty cell method.

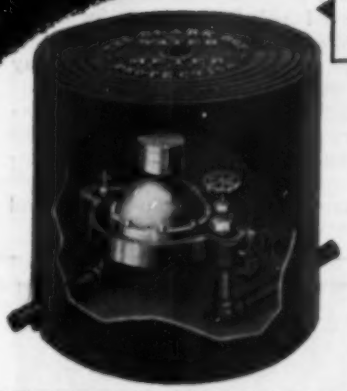
• • •

Cleaning a Four-Mile Long Beach At a Florida Resort

A machine devised by the Superintendent of the City Garage is used to pick up the windrows of sea-weed on a public beach in Florida. A side-delivery rake is used to windrow the sea-weed; these windrows are then picked up by the special machine and loaded by conveyor belt into a trailer. On the 4-mile beach, use of this equipment reduced the maintenance crew requirements by two men.

CLARK METER BOXES AND COVERS
OF CAST IRON

Left, No. 16 Clark Wonder Lock Meter Box Round....16" and 18" diameters. Large 13" lid.



Above, No. 11 Oval Clark Wonder Lock Meter Box, especially for warmer climates. H-11", L-18", W-12".

Below, A-2-13 Clark Meter Box Cover with screw lock. Height 4", lid opening 13".

Above, A-2-11 Clark Single Lid Meter Box Cover, 4" throat. Also available in 6" and 9" throat.

Below, B-2-11-L Clark Double Lid Meter Box Cover, 6" throat. Also available in 4" and 9" throat.

Above, AA-3-12 Clark Meter Box Cover with 13" Wonder Lock Lid, for use with 15" (illustrated), 18" and 20" box body.

Improved Screw Lock with strong forged bronze bolt.

Wonder Lock Lid (bottom view) showing forged bronze bars.

Perfect Lock of one-piece manganese bronze forging.

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EQUIPMENT PROCUREMENT and REPLACEMENT

Portions of a paper on this subject which was presented to the Municipal Maintenance Problems Conference, University Extension Division, University of Wisconsin, by R. V. Cummings, Governmental Representative, Caterpillar Tractor Company.

THIS PAPER presents data on how to gather the facts necessary to buy and to replace construction and maintenance equipment on an economical basis. The equipment discussed includes all items for which there are no standard specifications and which requires a sizable outlay of capital to purchase. The AASHO Manual of Uniform Highway Accounting Practices lists some 98 items that fall into this general category. It includes items from air compressors to welding outfits and from motor graders to rippers.

There's no second chance for engine-powered auxiliaries on fire-fighting equipment when life and property are at stake. The engine must start — and fast! And it has to be dependable now, tomorrow — and whenever needed.

That is why the auxiliary power unit for the famous "Snorkel" shown above is built around a 22-hp Model VF4 Wisconsin Engine. Proved and hailed by the Chicago fire department, the "Snorkel" — made by Pitman Mfg. Co., Grandview, Mo. — has a fast, safe eight-story reach for pin-point fire-fighting and saving victims.

The rugged Wisconsin was chosen because it is precision-fitted for smooth-firing power and minimum wear. And its basic high torque prevents stalling under sudden shock loads — a blessing in life-saving.

Trouble-free air cooling compounds the benefits. It provides all-weather dependability in temperatures from sub-zero to 140° F. It slashes upkeep because there's nothing to dry-up or freeze-up. You don't need water or anti-freeze — no radiators, water pumps, fan belts, and other water-cooling parts to buy, wear, or replace.

Whether you use engine-powered equipment for emergency services or to cut costs — specify Wisconsin Engines. Sizes from 3 to 56 hp. Electric starting available for all models. Get Bulletin S-251. Write Dept. U-20.

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U-213

To do a job of cost accounting, all that is required is that an accurate record be kept of the individual expense related to each piece of equipment. This is the mechanical part of the job and the information obtained can justify the purchase of the best equipment.

Operating cost data must be kept on a day-to-day basis by the operator or superintendent. On a regular weekly or monthly basis it is posted on a permanent file. At the end of the year the monthly figures give the total cost of operation and the hourly cost of each machine.

Up to this point only the mechanics of getting information have been discussed. Here is how this information can be used for the procurement, selection and retirement of equipment.

Starting with the problem of retirement, assume that the machine has now reached eight years of age. This arbitrary figure doesn't mean that the machine is ready for retirement but rather that time should be taken to decide if the machine is still economical to operate. From the history file on this machine it is easy to see what it has cost over the years to operate. These records may show that the hourly operating cost is beginning to grow, that the number of hours the machine is working has dropped severely and that repair costs are on the rise. These may indicate that downtime is beginning to reduce the availability of the machine. If this is the case, consideration should be given to the purchase of a new machine. Justification for the decision is in the records. These can show that it is costing more to operate this old piece of equipment than it would to purchase a new machine.

Let us assume for the purposes of this discussion the decision has been reached to retire this machine. Therefore, it will be necessary to procure its replacement. In selecting new equipment, several questions will arise: 1) Will a machine of the same size and type be adequate for the job? 2) What makes are available in this type and size classification? 3) What is the reputation of each of the dealers who will be involved? 4) What do the records indicate each machine will cost to operate?

Question No. 1 can best be answered by citing an example: As-

sume you are retiring a 1-cubic yard track-type front end loader. It has been used primarily to operate a sanitary landfill. However, since its purchase there has been a 50 percent increase in your population and the machine has enough capacity only to keep the refuse compacted during the course of the day. The operator works overtime to cover the fill each night and must work Saturdays and Sundays to open new trench. In this case, it would be logical to assume that it would be cheaper to buy a larger machine and save the cost of the overtime wages. A 1½-cubic yard machine would probably solve this problem. But, there could be several other solutions, as use of a different type of machine. There is one other situation that should be mentioned at this time. When a machine is working two applications, such as loading stockpile material and operating on a sanitary landfill, it is a good idea to watch for the time when each of the jobs could keep a smaller machine busy. A machine can be selected, not on the basis of its versatility but because it is designed to do the specific job best. The stockpile job perhaps can best be handled by a rubber-tired front end loader and the landfill job by a track-type front end loader. With varied jobs the track-type machine is the more versatile.

Answers to question No. 2 are available through many sources. To answer question 3 requires discussion of each dealer in regard to equipment for major service jobs; parts supply; field service; length of time in business; his reputation and that of the manufacturer he represents; and his proximity.

To answer fully question 4, the cost records must be available to indicate what each machine will cost to operate. From the records, it can be determined how much it will cost to operate any given piece of equipment. This record can be set up in chart form so that it is possible to make comparisons of the makes with which the community has had experience, and on a purely factual basis the equipment that is the best and not necessarily that which carries the lowest price can be bought.

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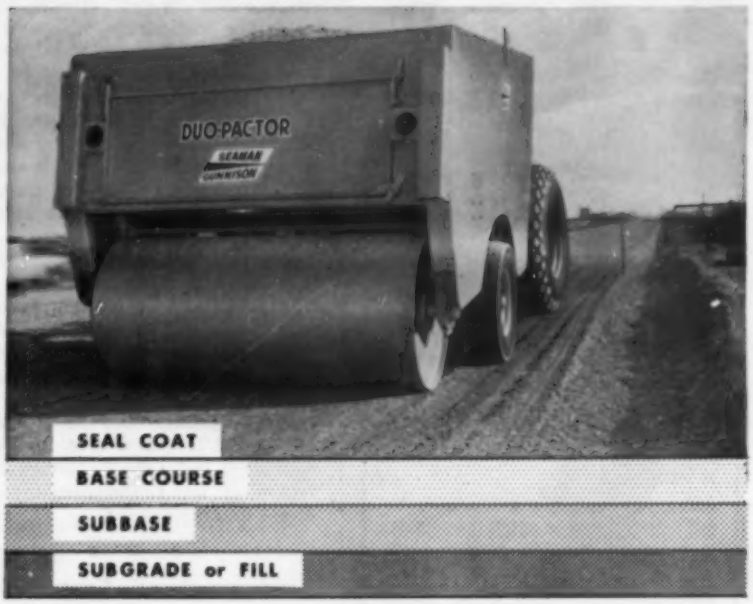
Public Health Service to Sponsor Water Pollution Conference

A national conference on water pollution is to be held at the Sheraton-Park Hotel in Washington, D. C., December 12-14, 1960. Theme of the



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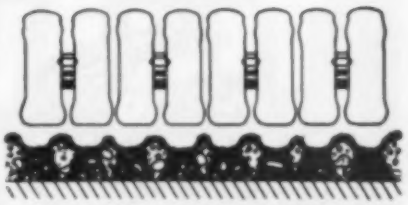

The closely spaced rubber tires form compacted tracks of *high* density.

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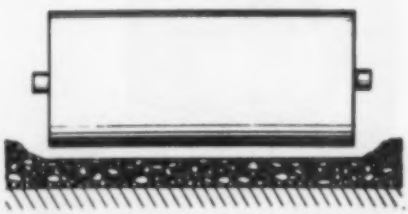

The steel roll chokes in the ridges between tire tracks, assuring *uniform* density.

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conference will be "Problems and Progress in in Water Pollution Control." The conference will seek to assess the status of the water pollution problem, as it relates to the Nation's total water needs now and in the foreseeable future, to pinpoint the barriers that presently stand in the way of progress and to reach agreement wherever possible on methods and means for solving the problem. Invitations are being issued to organizations of municipal, State, and interstate agencies, and to industrial, conservation, agricultural, civic and other groups. More than a thousand representatives from these groups are expected to attend. Frank Butrico, Chief of the Office of Engineering Resources of the Public Health Service has been appointed full-time Executive Secretary of the conference and will direct its organization.

• • •

Automatically Controlled Diatomite Filter Plant

An automated filter plant installed in a brewery to clarify city water for bottle washing and process water will pay for itself in less than a year in reduced labor costs. Two R. P. Adams, diatomaceous earth filters with automatically timed filter cycles deliver "highly-polished" water to a 30,000-gallon storage tank at Liebmann Breweries, Inc., Brooklyn, N. Y. The brewery requires exceptionally clear water for product quality control.

In operation, two Adams filters are connected in parallel between the city water main and the storage tank. The sole manual operation is filling the slurry mix tank with diatomite and water. Once this is done, continuous filter aid feed is provided by gravity from a tank.

One of the two filters is on-stream at all times; the other is on a stand-by basis, cleaned and ready for precoating. After a predetermined interval, a timer starts the precoating of the second filter on stand-by and puts the filter on-stream, the first filter meanwhile being in operation. When the first filter is taken off the line, backwashed twice and held on stand-by—all without interruption to the flow of filtered water—the second filter takes over. Control is by Taylor Instrument timers.

A high-level control on the storage tank puts the on-line filter into recirculation if the tank level reaches a maximum point. A flowmeter is connected with a constant valve to provide a nearly constant maximum filter output regardless of

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pressure loss across the filter. As the first filter approaches backwash time, this control will throttle the second filter flow to provide the maximum desired flow through the system during the switchover interval.

The center of the automatic system is a master timer which can be fitted either with electric or pneumatic functions. An auxiliary timer controls the length of the filter cycle. Valves are pneumatically actuated.

Aside from the labor-saving factor, there are other advantages in automated filtration. It permits remote location of the plant, where desirable, since few inspection trips and almost no attention are required. It is readily adaptable to a wide choice of systems; virtually every model of filter can be automated. Also, fewer filters are required for a given output in a multiple-filter plant, since fewer filters need be off the line at any time for manual backwashing and precoating.

• • •

Water Quality Measurement and Instrumentation

The Water Quality Measurement and Instrumentation Symposium will be held August 29-31 in Cincinnati at the Hotel Sinton and at the Robert A. Taft Sanitary Engineering Center. The three-day symposium will consist of 28 technical presentations on four major topics: 1) The definition of the role of water quality measurement in water resources management; 2) the review in broad terms of the methodology, collection, and utilization of water quality data; 3) the review of available instrumentation and the highlighting of developmental needs; and 4) the discussion of methods of data transmission, distribution, evaluation, storage, and other factors concerned with data handling and utilization.

Particular emphasis will be placed on the availability of and/or the need for further development of automatic instrumentation for the measurement of water quality. Technical presentations will be made by representatives of the PHS, State and local agencies, universities and related industries.

A detailed preliminary agenda and full registration information may be obtained by writing to: The Director, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio.

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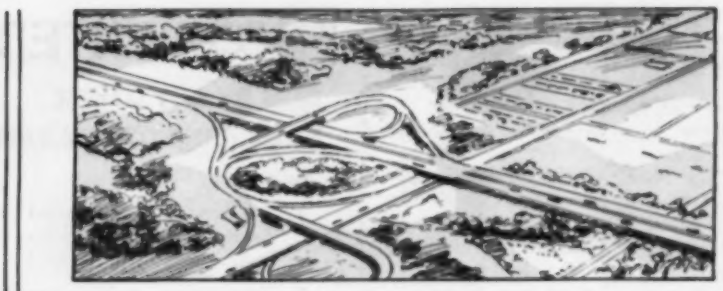


Prepared by **L. G. BYRD,** *Associate Editor*

Public Transit on Freeways

Long range plans for transit service operation in the general traffic stream meet many valid objections. One likely alternative being explored would provide sufficient median space in the freeways now under design to permit future construction of special bus roadways or rapid transit railways. A 64-ft. center mall would be required for this ultimate design. Development of the ultimate facility could be carried out in four stages. First, the median would be turfed and landscaped to provide safety of directional roadway separation and storage area for snow removal operation. In the second stage, the median would be converted to a 3 lane roadway operated in reversible directions to accommodate peak flows of general traffic. The center roadway would be converted to two-way bus operation in the third stage. In the final stage or as an alternate to the bus roadway, the center mall would accommodate some form of fixed-track rapid transit system.

"Public Transit on Freeways." W. R. McConochie, Chief Engineer, Traffic and Transit Department, De Leuw, Cather & Co., Chicago, Ill. *The American City,* May, 1960.

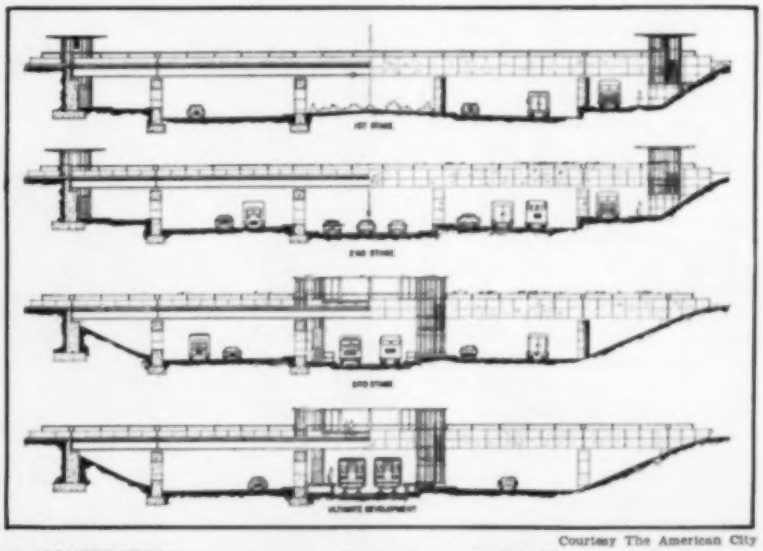
Airport Runway Pavement Design

At the end of ten years of service Baltimore's Friendship Airport runways are still in excellent condition. Original construction during 1947-1949 provided for a 10-in. bituminous concrete pavement on 5 in. of selected subbase material on runways. This runway pavement section was designed for 100,000 lb. wheel loads. The 10-in. asphaltic concrete was placed in four courses: A 3½-in. base course; another 3½-in. course using the same mix design of bank-run sand gravel aggregate; a 1½-in. subsurface course; and a final 1½-in. surface course—both surface courses using a crushed stone aggregate. The runways and taxiways were then covered with a seal coat. The pavement construction including heavy compaction of the subgrade cost under $3 psy. Minor maintenance and repair activities have been required to correct minute cracks along paving machine joints, cracks and raveling at two locations of taxiway junctions, and surface erosion caused several years ago to small areas at the ends of runways by Navy jets then using the airport. Thin solvent-resistance bituminous seal coats are applied every other year to surfaces subjected to fuel and hydraulic fluid spillage. In 1959 construction was undertaken to further improve accommodations for the new commercial jet aircrafts. The pavement design section on this later construction consisted of 10 in. of bituminous concrete on 10 in. of selected subbase material.

"Sound Engineering and Planning Pays Off for Airport." Joseph E. Laird, Executive Director, Maryland Asphalt Association. PUBLIC WORKS, June, 1960.

Guard Rail Washer

The Equipment Shops of the Texas Highway Department have built a machine for effective mechanical washing of single-faced beam type guard rail mounted as a median barrier on express-type highway sections. The machine is a trailer-type unit mounting a square 500 gal. tank holding a detergent solution. It is pulled by a tank truck containing 1000 gal. of clear water for rinsing. The three working units of the machine consist of: A swinging arm piping the detergent and clear water to spray nozzles; a whirling black nylon brush powered by a motor and mounted on the swinging arm; and four fixed brushes for initial scrubbing action. A coil spring fastened to the swinging arm



Courtesy The American City

● **ILLUSTRATING successive stages in development of public transit on freeways.**

$278 monthly operates landfill

City of 6,100 points to speed of Michigan Tractor Shovel as main reason for 80% cut in disposal time (and expense)

Landfill garbage disposal with a rubber-tired Michigan Tractor Shovel has drastically cut expenses in Buchanan, Michigan.

To operate their 11-acre ravine landfill with the Michigan has cost the city *only $10,006.62* for the past three years! *Previous crawler-handling averaged four to five times as much.*

Handles maintenance in spare time

Complete disposal for the city's 1,660 homes and 171 stores and restaurants *is now done in two hours a day* (compared to crawler's eight to ten hours) . . . spare time is put to profitable use by driving the 26 mph Michigan all around town under its own power to do wide variety of loading, unloading, grading, and dozing jobs.

Compaction made after coverage

In normal operation, *garbage*, dumped by a 16-yd packer and four open-type trucks, is dozed at end of each day into marshy bottom-land, then covered with 6 to 12 inches of Michigan-excavated bank-run sand and clay. *Refuse*, averaging 200 cu yds is brought in once a week, with cover made by the 1¼ yd 4-wheel-drive Michigan the next morning. After coverage, the fill areas, which have been limited to 30 ft width, become roadways and turn-arounds for both trucks and Michigan. No pre-fill compaction need be done.

"Could dig trenches"—Supt.

"We've found sand ideal for this fill-before-compaction method," advises Supt. Mike Hankila, "but I think good compaction can be accomplished *after* coverage no matter what the material. We find the ravine-fill method least expensive, too, but *if* we ever *must* dig disposal trenches, Michigan's performance in hard clay—in digging on steep slopes —and in excavating axle-deep mud—assures us it can adequately do this job too."

In three years, only one tire puncture

In all its work over the past 36 months, Michigan repairs have cost only $2028. Tires ran on original treads over the entire period. Only one puncture was experienced. It resulted from an 8" spike on the dump. Dismount, patch, and re-mount took only two hours. City Manager John Kennaugh credits this long, trouble-free service to (1) the method of operation where cover is made prior to compaction, (2) intelligent operation such as elimination of "cowboying," and (3) Michigan's efficient all-Clark power train which virtually eliminates wheel slip on turns and under load. "Now that we know how efficiently a rubber-tired Michigan works at the dump—and how many maintenance assignments it speeds," says Mr. Kennaugh, "we advise every city to *try* the Michigan method!"

Typical Michigan odd job: truck-loading large tree sections. Other recent assignments: lift old concrete wall, 10 ft long, 4 ft wide, 1 ft thick, *weight 6,000 lbs.* Backfill and load excess dirt from sewer and water main installations. Grade parking lots and play grounds. Cut down banks along streets to improve visibility. Unload tile and water and sewer pipe from trucks and rail cars. Load salt-trucks for winter-time ice-control. Remove snow.

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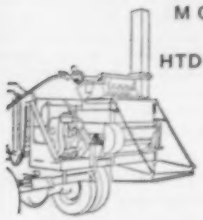


McCONNAUGHAY MIXERS, INC.—LAFAYETTE, IND.

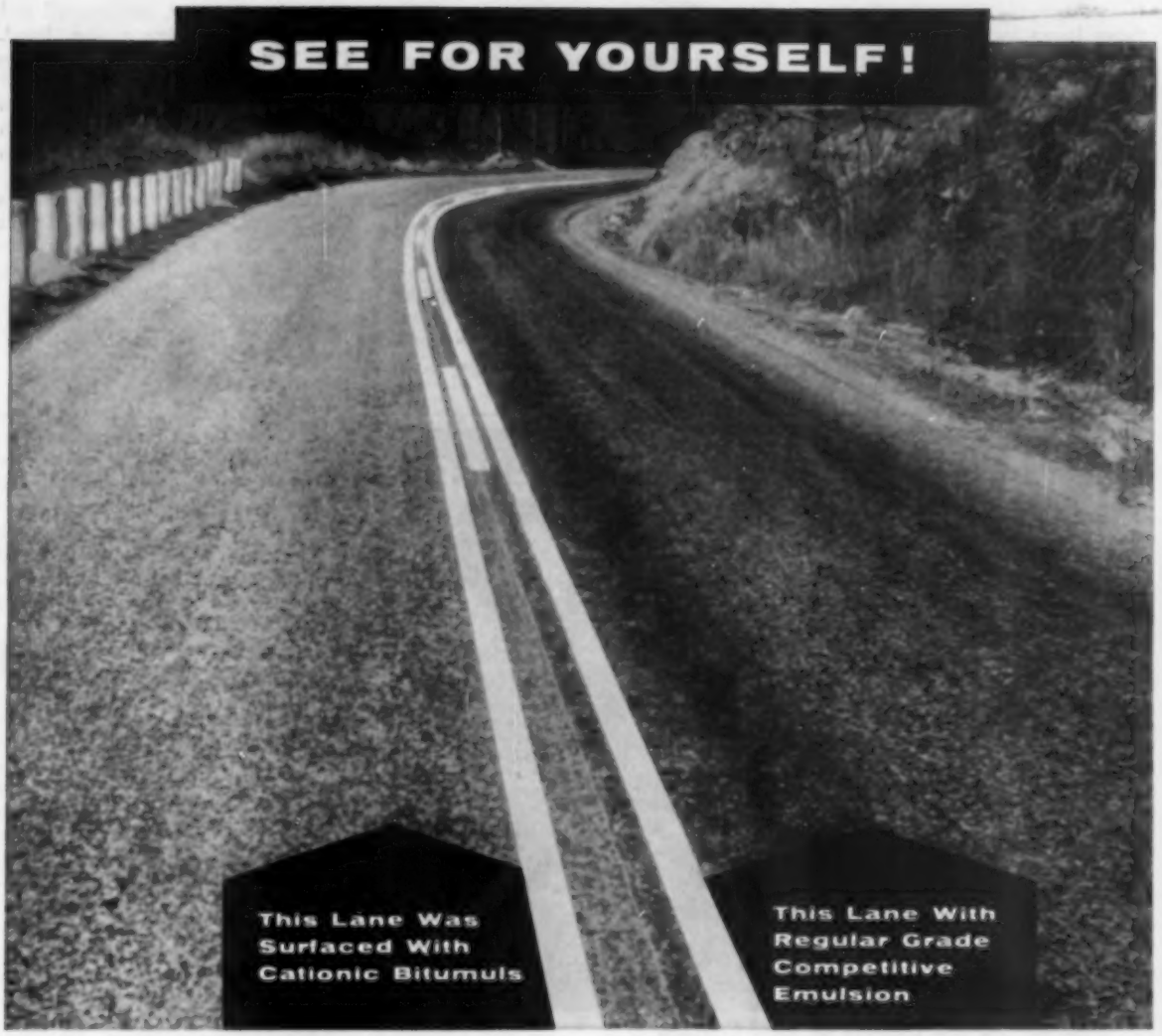
National distributors: Asphalt Equipment Co.
3314 Cherry Lane, Fort Wayne, Indiana

permits it to be folded back against the tank to clear obstructions or for transporting.

"Guard Rail Washer." *Texas Highways*, May, 1960.

Accident-Highway Cost Relationship

An accident cost study conducted in Massachusetts in 1954-55 revealed, in terms of accident rates and direct costs of accidents, the efficiency of the highway system. The State's highway network consisted of three general systems: Federal-aid primary, Federal-aid secondary and non-Federal-aid. Within each system two classifications are made: State highways and local roads. The total highway network in 1953, the study year, amounted to 24,506 miles on which 11,628 million passenger vehicle miles of travel occurred. In the same year there were 131,536 passenger-car accidents resulting in direct costs of $50,224,000. Of all accidents in the State, 88 percent occurred on the urban highways and streets representing about 25 percent of the total State system mileage. Two-thirds of all accidents occurred within city limits. In terms of severity, 75 percent of all accidents involved property damage only. Accidents occurred at the rate of 11.6 per mile of State highway and 4.7 per mile of local road while accident rates per 100 million vehicle-miles were 525.27 for State highways and 1,538.75 for local roads. Comparisons of the number of accidents per mile of highway and number of accidents per 100 million vehicle-miles were studied in relation to the respective systems to see if the reasons for the reversal of accident rates in the two systems might be determined. No definite indications or trends were detected though there did appear to be a relationship between the vehicle-mile accident rate and the average traffic volumes. On the cost side of the ledger, fatal accidents accounted for 3 percent, nonfatal injury accidents 57 percent, and property-damage-only accidents 40 percent of direct costs. The highest accident cost per mile of highway was $16,112 on the Federal-aid primary local roads. Federal-aid secondary State highways were second high at $6,857 and third were primary State highways at $6,537. Accident costs per mile, of course, do not reflect volumes of traffic carried. Costs in terms of vehicle miles showed State highways costing the motorist an average of 0.28 cent per passenger-car-mile and local roads 0.53 cent. Detailed tables and charts developed



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from this study cover, in addition to those items mentioned, direct costs by highway system and severity, direct costs per traffic accident and accident rates and costs as affected by control of access.

"The Economic Cost of Traffic Accidents in Relation to the Highway Systems." Bernard B. Twombly, Traffic Engineer, Massachusetts Department of Public Works. *Public Roads*, June, 1960.

Epoxy Resins in Bridge Repair

Fifteen concrete bridge pier caps were repaired by the Texas Highway Department using epoxy resin as a bonding agent between the old and new concrete. Spalling had occurred on the faces of the caps due to movement of the deck slabs where they were tied to the caps by steel dowel bars at fixed construction joints centered over the piers. The dowels were cut to relieve the tensile stresses in the concrete before repairs were started. Repair procedures included removing all unsound concrete, sandblasting the surface, final cleaning with compressed air, brush painting the surface with epoxy resin, building up a new concrete surface with a sprayed-on mortar, striking-off and finishing the surface by hand. The first group of repairs were about 75 percent successful. Later repairs with more experienced crews rarely resulted in failures though age of work is not yet sufficient to permit long range evaluation.

"Use of Epoxy Resin in Bridge Cap Repair." C. H. Brown, District Construction Engineer, Texas Highway Department, Beaumont, Texas. *Rural Roads*, May, 1960.

Bridge Deck Deterioration

Extensive failures of the concrete wearing surfaces of recently constructed concrete bridge decks has generated much discussion by design, material and construction engineers. Excessive cracking, pop-outs and spalling are the readily observed surface failures sometimes accompanied by unobserved deterioration of the structural deck concrete under the wearing course. While no firm answers to these problems or their correction are available today, several techniques are being employed which show promise. Intelligent use of admixtures, careful embedment of reinforcing steel (to a minimum of 2-in.), scientific vibration and strict curing practices can contribute to the quality and durability of structural concrete. Protective materials such as silicones or epoxy resins will greatly enhance the concrete durability. Concrete requires constant quality control since it is a job-site produced material subject to all of the varying conditions of design, construction methods, inspection and weather.

"The Problem of Bridge Deck Deterioration." H. B. Britton, Senior Structural Specifications Writer, New York State Department of Public Works. *Roads and Streets*, May, 1960.

Mulching Seeded Highway Slopes

Since 1938 Ohio has included the use of straw mulch in its successful highway seeding operations. Trial and error in developing a procedure for holding the mulch in place included use of tree branches, soil and twine. The practice of binding the mulch in place by a pattern of twine held down by wooden pegs is still in the specifications but is used infrequently and only on small jobs today. Various types of equipment were devised to distribute the mulch and to hold it in place. From many

HI-WAY Model J Traction-Type Tailgate Spreader

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early models the present power mulcher was developed to blow the mulch onto the surface in a uniform pattern while concurrently spraying the straw with asphalt droplets to bind the pattern into place. The accepted benefits of mulches in reducing erosion, slowing down soil moisture evaporation, maintaining a more uniform soil temperature and eventually shading the seedlings have led to the development of many other mulching materials. Lumber and pulp mill by-products, ground corncobs, synthetic materials and paper are now available in forms usable for this purpose.

"Mulching Seeded Areas." Wilbur J. Garmhausen, Chief Landscape Architect, Ohio Department of Highways. PUBLIC WORKS, June, 1960.

New Streets in Urban Renewal

In an analysis of 122 urban renewal projects, the U. S. Urban Renewal Administration found that a substantial part of the cost of redevelopment lay in the provision of new public works and that 33 percent of this public works figure was accounted for by new street work. Such projects often provide opportunities to create entirely new patterns of land use, including redesign of street patterns. The typical urban renewal program creates two types of street engineering problems: New streets within the redeveloped area and redesign of streets adjacent to, or serving, the area. In addition, traffic to and from a new development often necessitates a review of the entire arterial highway plan.

"Street Revamping Major Item in Urban Renewal." Duane L. Cronk, Director, Highway Information Services, Washington, D.C. *Street Engineering*, May, 1960.

Other Articles

"Lime Stabilization Corrects Bad Subgrade." The use of a lime slurry, mixed by ready-mix trucks and applied through a fertilizer spreader, enabled Hillsboro, Kansas, to effectively use local materials in base construction for city streets. PUBLIC WORKS, June, 1960.

"Single Operation **Paints Center and Edge Lines.**" Revisions to a large truck striper permitted the Ohio Turnpike to apply center and left edge lines concurrently with resultant savings in both time and expense. By B. H. Bowman, Traffic and Safety Engineer, Ohio Turnpike Commission. PUBLIC WORKS, June, 1960.

"Lighted, Paved Streets Come With The House." **A complete street lighting system** is installed as a part of initial subdivision development in the Lake

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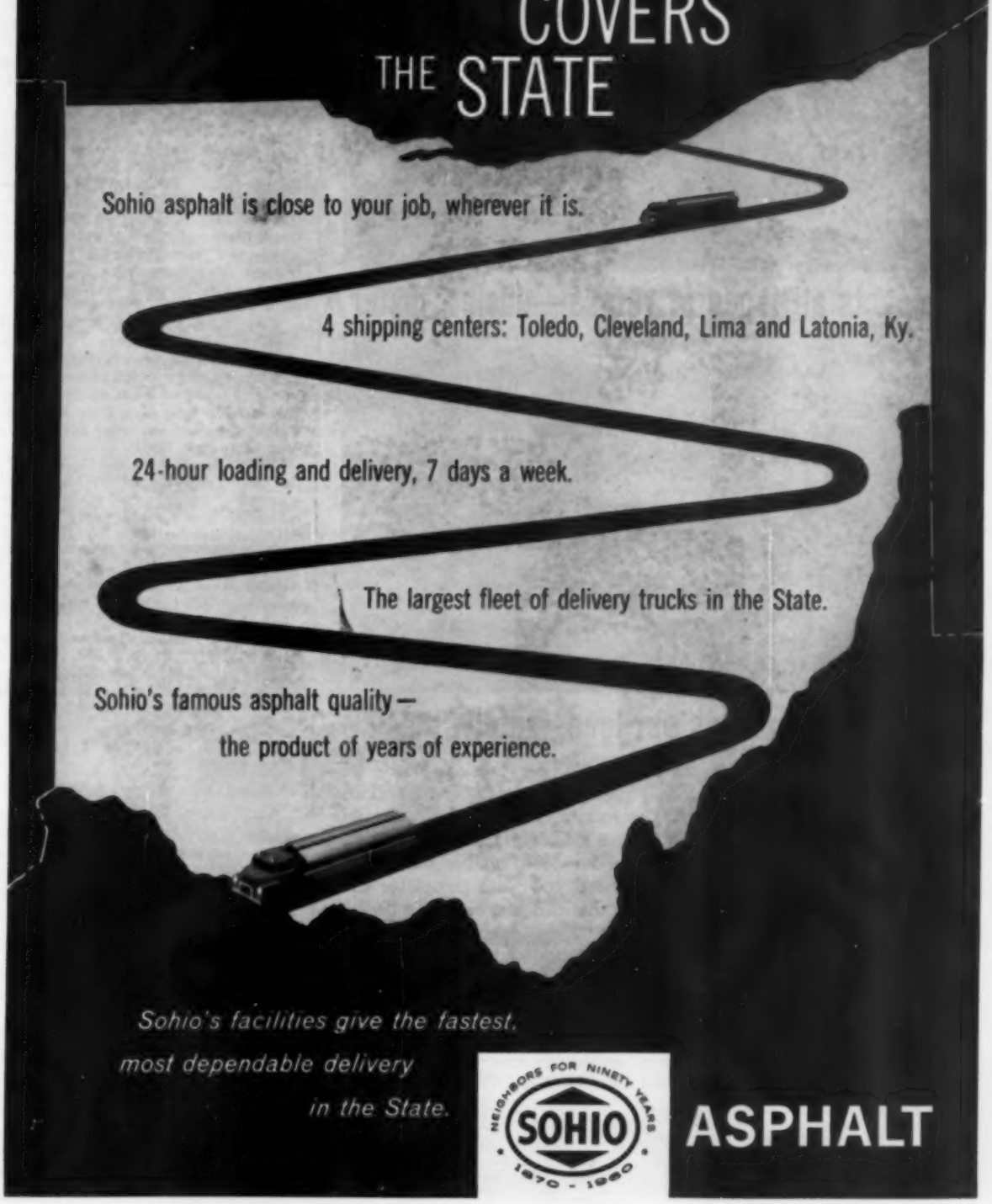

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Shores subdivision of Fort Wayne, Indiana. By Joseph Lebrato, Lebrato Brothers, Incorporated, South Bend, Indiana. Street Engineering, May, 1960.

"Median Barrier Gates Help Handle Expressway Emergencies." Through the use of retractable openings in the median guardrail, Detroit's expressways are kept safe guarded during normal operations and flexible to handle emergencies when required. Street Engineering, May, 1960.

"Surface Water Run-Off, Methods and Assumptions In Its Calculation." By J. C. McIntosh. Contractors Record and Municipal Engineering, May 4, 1960.

"Research in **Asphalt Quality Control."** Part III of this series of articles deals with structure in asphalt. By Dr. R. N. Traxler, Research Engineer, Texas Transportation Institute. Texas Highways, May, 1960.

"New Maintenance Aid — **Seeded Grass Blankets."** Seeded grass blankets which can be easily rolled out and tamped down have been successfully tested at the University of New Hampshire. Rural Roads, May, 1960.

"City Road-Mixes and Stores Its Topping." Pacific Grove, California **road-mixes bituminous surfacing material,** transports it to public works yard in quantity and stores it, ready for use. By M. M. Fritschle, City Manager, Pacific Grove, California. The American City, May, 1960.

"Bridge Decks Repaired Under Traffic." Major deck repairs involving novel suspended forms were made in the midst of heavy traffic near Detroit, Michigan. Roads and Streets, May, 1960.

"A $500,000 Shop, and Worth Every Cent." Seattle, Washington, gets the maximum use of its equipment through a modern, efficiently run **repair shop.** Modern Highways, May, 1960.

"Offstreet Parking Garages for New York City." A study of the need for providing 10,000 offstreet parking spaces in the mid-town area. Public Works, June, 1960.

• • •

Patching a Bridge Surfacing

Application of a quick-setting mortar topping material to a spalled section of roadway surface on the Brooklyn Bridge some 18 months ago saved the contractor two entire road-laying operations while making it possible to open that section to traffic the morning following application. The material used for the job was Permatop, a hard surfacing adhesive product which forms an indestructible bond with concrete surfaces and cures within eight hours. It is a product of the Permagile Corp.

On the Brooklyn Bridge, the plastic-like material was applied to a spalled area of several thousand square feet on the ramp approach to the Manhattan side of the bridge.

The job was completed in six hours, using no other tools than a surface trowel and a wooden screed.

The topping was poured directly over the spalled surface to a depth of ⅛ inch. This was sufficient to provide complete protection against the heavy traffic conditions. Once set, the overlay is waterproof and weatherproof and it resists damage from oil, grease, salt and gasoline.

The only requirement for application is a clean, dry surface. Once a roadway is swept clean, the preparation of Permatop can go ahead. This is done by mixing Permagile base with a liquid reactor and a few minutes later with a chemically treated aggregate. The result is a viscous substance that can be applied immediately.

Though Permatop is naturally skidproof, the Brooklyn Bridge workmen gave a rough broom finish to the repaired surface. The ramp approach was ready for use the morning after work, although it was not actually opened to traffic till later, owing to other bridge repairs that were then in progress.

After more than 1½ years of service, the new topping shows no sign of wear. A slight darkening of the surface can be attributed to the normal effects of heavy traffic.

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A CONTRACT recently awarded the Huber-Warco Company of Marion, Ohio, by the Corps of Engineers, U. S. Army, calls for a total of 709 motor graders of the 125 hp class to be built and delivered over an eleven month period. The graders will be used all over the world, on all types of construction and maintenance work, and by the Army, Navy and Air Force. The military version is a standard production model except for some units which are winterized. These units are engineered for operation in —65°F. temperature. Special heating and defrosting equipment maintains the operator's cab temperature at approximately +40° and 75 percent of the windows frost-free in a 5 mph wind.

Among the tests required by the

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Operating like a giant vacuum cleaner, the Leaf Collector pulls leaves and litter (wet or dry) into its 14 cu. yd. self-dumping hopper for quick easy disposal. Sturdy flexible intake hose covers a 6-foot path and can be maneuvered into hard-to-reach places. Heavy-duty 4-cylinder industrial engine drives the abrasive-resistant fan.

The Good Roads Leaf Collector is a favorite with maintenance departments because of its speed, flexibility and operating economy. Its low initial cost is usually recovered by man hours saved in the first season of operation. Available truck or trailer mounted. For complete details, see your Good Roads distributor or write:

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Attractive Municipal Garage Blends With Local Residences

● PUBLIC WORKS garage in Bayside, Wisc., has rigid-frame steel construction.

VILLAGE officials of Bayside, Wisconsin, recently were faced with a rather unusual problem. Bayside, a suburb of Milwaukee, needed a new garage for its public works department. The most acceptable site for this garage was located in a high-income residential area, so the garage had to be attractive as well as economical.

Village officials were already convinced of the inherent economies of pre-engineered rigid-frame steel construction. However, they were concerned about the exterior appearance of such a building. After further consultation with the building dealer, they decided on an Armco rigid-frame building with masonry sidewalls. In the design stage, the building was color-coded by the Sherwin-Williams Paint Company to blend with the surrounding homes.

The new garage is 60 ft. wide, 120 ft. long, with a 14 ft. wall height. It has been designed to withstand a 30-lb. snow load and a 20-lb. wind load in accordance with local building codes. The extra attractive features include a 5-ft. gable overhang and a 10-ft. eave extension in the front.

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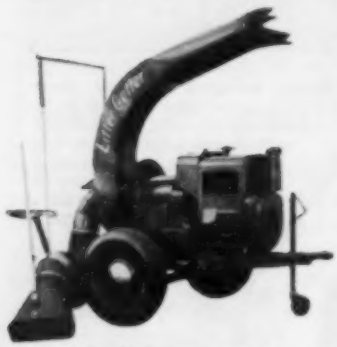

These are powerful vacuum-type machines designed for **rapid collection** of **Leaves** or **Litter** such as: newspapers, paper cups and wrappings, tin cans, pop bottles, ticket stubs, etc. Discharge material into truck mounted box.

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"Litter-Getter" Models: Model L. G., **Straight Trailer Mounting,** shown here is **quickly changed from right to left side pick up,** Model L. G., **Cross Trailer Mounting,** is equipped with a wide, semi-rigid suction snout for windrow leaf collection. Model L. G., **Skid Mounting** is used on dump truck or stake body truck ahead of the receiving box. Model L. G., **Tail Gate Mounting,** is used on dump truck tail gate.

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If you do your own spraying, use a *Gledhill Roadside Sprayer.* Now offers complete control of spraying width . . . economizes on chemicals and allows constant speed spraying regardless of width of spray being used.

THE **GLEDHILL** ROAD MACHINERY CO.

Galion, Ohio

from a task well done. Not so today, however, says a report of survey by Dr. Lee E. Danielson of the University of Michigan..

Dr. Danielson, Associate Professor of Industrial Relations and Assistant to the Dean, School of Business Administration, analyzed responses to questions put to 277 non-supervisory engineers and their immediate supervisors in ten carefully selected industrial firms. He says that today's engineer or scientist is more likely to be interested in personal advancement and recognition than in serving society or creating for its own sake.

When asked whether engineers and scientists differ as a group from other workers, and if so how, the supervisors and non-supervisors questioned gave the following answers: 1) Engineers and scientists are more responsible, objective and involved in their work than are other groups; 2) they require greater freedom and more individualized and less routine supervision; 3) they have a greater need for tangible and intangible rewards for their work and ideas; 4) they are more ambitious, creative, analytical, introverted and emotional; and 5) their goals are broader, higher, and more definite.

In addition the author pinpoints causes of satisfaction and dissatisfaction of engineers and scientists in their work and in their relations with others in their organizations. Reasons most often given by engineers for job satisfaction included: 1) Visible results of effort and opportunity for following jobs through to completion; 2) challenging and varied assignments; 3) recognition by others; 4) utilization and extension of their abilities; 5) relations with others; and 6) opportunities for growth and advancement.

In general, dissatisfactions resulted from differing conceptions on the part of engineers and management as to the proper status and duties of engineers and scientists within a profit-making organization. In his recommendations, Dr. Danielson gives specific advice to higher management, first-line supervisors of professionals, engineers and scientists, and colleges and universities for maximum utilization and satisfaction of engineers and scientists in industry.—*From "Engineering Employment Practices Newsletter", NSPE.*

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- Fast highway speed between jobs
- High speed production of 1, 2, or 3 lines, solid or intermittent
- Instant "Finger Touch" all-electric intermittent Control
- Steerable guns for fast, accurate retracing

Here's a big striper with the versatility to mark centerlines, or centerlines and edge stripes simultaneously. Fast and maneuverable, the low-cost M-B Pacemaker 88 includes an adjustable guide pole and caster wheel, air lift of outrigger guns, positive reflective bead control, plus many more exclusive features. Note full-vision, high, safe position of operator.

Send for information on the complete line of M-B markers, including custom designed heavy duty models specifically designed for your use that are comparable in price to "assembly line" machines. M-B Corp., New Holstein, Wis.

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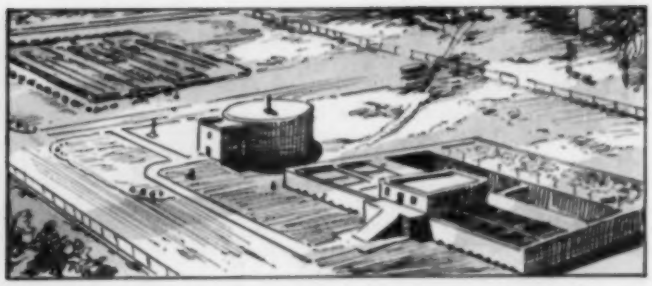
THE SEWERAGE AND REFUSE DIGEST



Prepared by **ALVIN R. JACOBSON, Ph.D.**

Associate Professor and Head, Division of Sanitary Science, Columbia University School of Public Health

Economics of Sewage Treatment

The building of new towns in Great Britain in post-war years, as well as the creation of joint drainage undertakings have provided a unique opportunity to study costs of modern sewers and sewage works of all types and sizes. All of the cost figures quoted are calculated at 1959 price levels. The economics of waste-water treatment are influenced considerably by the degree of centralization of disposal in any district. Equally important is the method of operation of sewers—whether combined or separate—and the maximum volumes of wastes delivered to the sewage works. The volumes of domestic sewage and trade effluents have been rising steadily until about 40-50 gals. per capita per day is now quite normal in urban areas. Current practice is tending to allow for a maximum flow rate of about 240 gcd. Sewer costs range from a high of about $112 per capita for small housing developments to a minimum of $56 per capita for a population of 50,000, the cost increasing steadily for cities of larger size. Over 90 percent of the total population of Britain is served by sewers with more than 60 percent served by plants providing complete treatment as recommended by the Royal Commission. The overall costs of sewage treatment ranges from about $50 to $34 per capita for plants serving 1,000 to 5,000 people, to about $22 per capita for plants for a population of 200,000. For larger population groups the cost will decrease more slowly to the region of $21 per capita for a plant serving one million or more. Modern works are adaptable to increasing mechanization and automatic control needing greater capital expenditure but with lower operating cost. The author discusses the many factors which have an influence on the cost of sewage treatment and disposal.

"The Economics of Waste-Water Treatment." By C. B. Townsend, Chief Engineer, Middlesex County main drainage department. *The Surveyor and Municipal and County Engineer*, 9 April, 1960.

Oxygen Absorption

Increasing interest in high-capacity aeration to supply sufficient air to satisfy the high oxygen demand rates in treatment of sewage and industrial wastes resulted in a study of the oxygen absorption capacity of the Hi-Cone aeration system at the Glendale, Ill., sewage treatment plant by the Metropolitan Sanitary District of Greater Chicago. The aerator is designed to introduce oxygen into a liquid media by continuous and rapid exposure of fresh liquid surfaces to atmospheric air. This rate of oxygen absorption is a function of the speed of the cone which causes a rapid turnover of the tank content. The oxygen absorption rate studies were made in a conventional concrete tank 28 feet square and 13.5 feet deep, with 3-foot, 45-degree bottom fillets. Measurements were made with the 6-foot Hi-Cone unit running at speeds of 25 to 39 rpm, and with the lip of the cone at ½ inch, 2 inches, and 4 inches above the water level. The oxygen absorption rates were measured by adding sodium sulfite with cobalt catalyst to the tank in a slight excess to deaerate the water. The tests at Glendale showed that: 1) The unit was capable of oxygen absorption

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in tap water of amounts up to 23.5 pounds per hour depending on the speed of the cone; 2) a unique method for obtaining uniform and representative samples was developed by using small submersible pumps; 3) complete and uniform mixing of the tank content is accomplished by the system; 4) the power consumption, expressed in kw-hr per pound of oxygen absorbed, did not vary significantly within the limits of the test and was approximately 0.36 kw-hr gross power consumption and 0.24 kw-hr when corrected for the efficiency of the motor-reducer unit.

"Studying the Oxygen Absorption Capacity of an Aerator System." By E. Hurwitz, Director of Laboratories, The Metropolitan Sanitary District of Greater Chicago. *Wastes Engineering*, May, 1960.

Plant to be Future Pump Station

To provide sewage treatment to a 311-acre area occupying one corner of a 5,180-acre drainage pattern with a minimum of future duplication or waste was a significant problem for the Des Moines Sewer District, south of Seattle, Wash., on Puget Sound. To make the problem more difficult, the focal point of the drainage from the 311-acre area was approximately one mile south of the most desirable treatment plant site for the ultimate 5,180-acre drainage pattern. Consulting engineers carried out engineering and financial feasibility studies encompassing several alternate possible sewer systems and their estimated costs. Population studies were made and analyzed from the standpoint of future development of the overall drainage area as well as for the immediate development of the existing sewer district. From these studies it was decided that the trunk sewer initially constructed to serve the 820-acre drainage area should be designed with sufficient capacity to serve that area in its ultimate development. Similarly, the other trunk sewers throughout the district should be designed to serve the ultimate development. Primary treatment with chlorination of the effluent and discharge to deep water in the Sound would be adequate according to the regulatory agencies. It was decided that the Spiragester, a two-compartmented treatment plant, which provides clarification in the upper compartment and sludge digestion below, would be an ideal solution. Ultimately the treatment plant will be converted to become a dry pit for horizontal-centrifugal type pumps. To facilitate this, three suction pipes were installed and equipped with blind flanges at each end. These pipes will ultimately be connected to the horizontal-centrifugal type pumps in what is now the digester portion of the Spiragester. Conversion of the Spiragester to a dry-pit room will be extremely simple with a minimum of waste and the least possible costs.

"Sewage Treatment Plant to Be Future Pump Station." By William J. Chase, Partner, Hill & Ingman, Consulting Engineers, Seattle, Wash. PUBLIC WORKS, June, 1960.

Wet Oxidation of Sewage Sludge

Chicago, Ill., and Wheeling, W. Va., will soon have installed the Zimmerman process of sewage sludge disposal. In this process, the sludge will be "incinerated" in the liquid form, freshly collected from the settling tanks. It offers the possibility of eliminating digesters, drying beds, vacuum filters and sludge incinerators. The new 200-ton-a-day wet-oxidation plant, being con-

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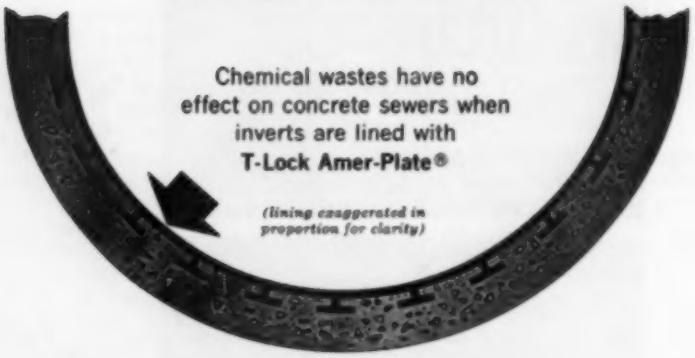
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structed at a cost of $11,870,000 for the Metropolitan Sanitary District of Greater Chicago, came as a result of a year-long study of a two-ton-a-day (dry basis) pilot plant at the District's West-Southwest Sewage Treatment Plant in which this method reduced volatile solids in the liquid sludge by 90% and total solids by 67.3%. This new plant will have four oxidation units, each capable of oxidizing 50 tons of solids a day. In addition, the plant will contain one turbo-generator installed to generate electrical power from gases emanating from the process. Wheeling, W. Va., the second municipality to adopt this process for sewage-sludge disposal, will have a plant with a capacity of only 5.6 (dry) tons of sludge per day. This capacity will serve cities of approximately 110,000 population. The Zimmerman process represents a departure from conventional methods of sewage solids treatment and disposal. It operates on the principle that organic matter contained in liquid sewage sludge can be oxidized (burned) in combination with an optimum quantity of air-borne oxygen without first being dehydrated by vacuum filtration or evaporation. Wet combustion, under proper conditions of pressure and temperature, generates heat in about the same quantities developed when incinerating conventionally dehydrated sludge. While temperatures within the process can be selected anywhere below 750° F. (the critical temperature above which water can no longer exist in liquid form), the high level of efficiency is about 500° F. The incoming sludge and air is passed through heat exchangers where the heat from oxidized sludge is used to preheat the raw sludge and air. At the present time, a model low-cost small unit, suitable for communities requiring one ton or less of daily capacity, is being installed at the sewage treatment plant in Wausau, Wisconsin.

"Wet Oxidation—A Fresh Idea in Sewage Sludge Disposal." By Frederick J. Zimmerman, President, Salvo Chemical Corp. (a wholly owned subsidiary of Sterling Drugs Inc.). *The American City*, May, 1960.

Model Sewer and Water Planning

New Hope, Minn., is one of those few farsighted communities which has actually planned for their population growth. This village located about 8 miles from the center of downtown Minneapolis, consists of

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5.1 square miles of rolling land suitable for building of split-level homes. It has good rail and highway connections to the city and other suburban areas providing easy access for the residents and industries to the metropolitan areas. With a dense clay soil, no public water supply or sewer system and no set of planning ordinances to regulate development, it was obvious that the Village of New Hope was going to experience some serious growing pains unless something was done. The village council employed the author's consulting engineering firm to make a preliminary study of the sanitary sewer requirements of the village. Aerial surveys were employed to provide a topographical map of the village for use in the engineering survey and later to aid in the assessment process. A planning Commission was established which, with the help of a consultant city planner, prepared an overall plan for the village and prepared the ordinances to implement it. Provision was made to set aside land for parks, schools, and playgrounds. The consultant city planner aided the Commission in the designation of areas that should be residential, industrial, or commercial and a general agreement was reached on the proposed street pattern to be developed. Consulting engineers planned and supervised the construction of the trunk sewers and the basic parts of the public water system. The foresight and courage of the officials of the Village of New Hope to follow the ideal method to develop a village was intended to avoid the problems of other suburbs in the area. The example should be seriously studied by new communities which may be faced with a similar problem.

"Model Sewer and Water Planning." B. F. G. Goff, Administrative Assistant, Orr-Schelen, Inc., Consulting Engineers, Minneapolis, Minn. *Water & Sewage Works*, May, 1960.

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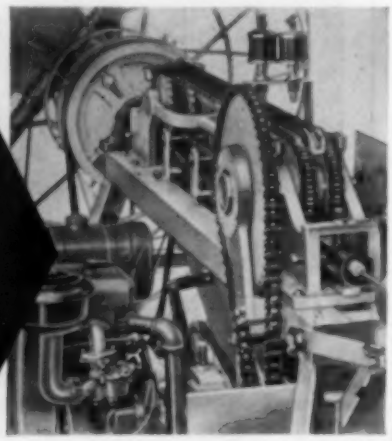

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Corrosion Prevention

Corrosion problems in sewer structures develop only when a substantial concentration of sulfides appear as a result of a combination of the following circumstances: 1) A high average temperature for at least six months of the year; 2) high concentration of organic matter; 3) long retention of wastes in the sewer, caused by long outfall lines, slow flow, flat grades, or accumulation in such areas as pumping chambers; 4) significant sulfate content. Under given sewage conditions, hydrogen sulfide (H_2S) is readily formed by the action of bacteria on organic matter and on sulfates in the sewage flow. The organism primarily responsible is Vibrio desulfuricans, which derives its energy from the dehydrogenation of many compounds and the reduction of sulfates. Many materials have been used as protective coatings with varying degrees of success, including sulfur, asphalt, coal tars, chlorinated rubber and sprayed vinyl. Heavy troweled vinyl resin applied in several coats to a thickness of ⅛ in. has given excellent protection over a 15-yr. period under most severe conditions. Recently various epoxy resins have been used but of several epoxy combinations tested in sewers only one or two have proved satisfactory for more than a year. Many installations of clay liner plate and tile have also been used successfully for long periods; but where corrosion is severe the method may be inadequate. High polymer vinyl chloride has been nearly ideal as a protective material. It is

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"Sewer Corrosion and Protective Coatings." By C. G. Munger, Vice President, Amercoat Corporation, South Gate, Calif. *Civil Engineering*, May, 1960.

Other Articles

"Land in **Sewage Purification.**" The agricultural disposal of sewage in Nottingham, England. By A. R. Stone, A. I. Mech. E., M. Inst. E., S. P.. Manager, City of Nottingham Sewage Works and Farms. The Surveyor and Municipal and County Engineer. 26 March, 1960.

"A Review of the Literature of 1959 on Wastewater and **Water Pollution Control.**" This section of the Literature Review covers analytical methods and sewage. By Research Committee, Water Pollution Control Federation. H. Heukelekian, Chairman, Journal Water Pollution Control Federation, May, 1960.

"**How Nitrates Reduced Odors** In Flooded Trickling Filters." Addition of sodium nitrate to influent of standard-rate filters controlled hydrogen sulfide nuisance at Atlanta. By Leonard E. Waller, Supt., South River Sewage Treatment Plant, City of Atlanta, Ga. and Robert S. Ingols, Prof. of Applied Biology, Georgia Institute of Technology. Wastes Engineering, May, 1960.

"**Computational Aids For Forecasting Water Quality.**" This paper describes how the buildup of chlorides can be followed in a reservoir under certain conditions of water reuse. By E. F. Gloyna and R. S. Schechter, Prof. of Civil Engineering and Assistant Prof. of Chemical Engineering, respectively. The University of Texas, Austin, Texas. Journal Water Pollution Control Federation, May, 1960.

"**Simplified Sewer Design.**" How a chart based on the Kutter diagram can be used for quick determination of pipe sizes required in storm and sanitary sewers. By R. B. Steytler. Public Works, June, 1960.

• • •

Plant Operations of the Middlesex County (N.J.) Sewerage Authority

THE ANNUAL report of operations for the Middlesex County Sewerage Authority for 1959 supplements the plant description and first year operating results which appeared in PUBLIC WORKS for December, 1959, and February, 1960. Sol Seid is Chief Engineer; M. C. Rand is chemist; A. A. Lach is plant superintendent; and Metcalf & Eddy consulting engineers.

The average flow during 1959 was 37.26 mgd. While monthly averages do not deviate widely from this figure, individual days following heavy or prolonged rains show flows greatly in excess of normal. These increased flows are accounted for in the metered flow from the participants, indicating that the infiltration occurs almost entirely in some of the older municipal collecting systems now tied into the trunk sewer. There was improvement in this respect in 1959 as compared with 1958, resulting from the efforts of some participating municipalities to eliminate infiltration.

The hour to hour flow variation is much less that at most plants, the daily maximum and minimum deviating from the average ordinarily by about fifteen percent. Also the high and low flows form broad plateaus on the chart rather than sharp peaks. The minimum flow is usually centered near the hour of 8 A. M., and maximum flows most frequently occur in the late afternoon. Several reasons account for these differences from the flow pattern observed at most plants. The great length of the system means that peak flows from various parts of the area served do not arrive simultaneously. Also, the trunk system, with its large diam-

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eter and length, much of it with relatively flat slopes, tends to equalize flows. About half the flow is industrial, and does not follow the usual domestic pattern. In fact, several large industries contribute essentially constant flows around the clock. Finally, the Sayreville Pumping Station does much to equalize the flow. This is partially intentional, through a conscious effort to hold the pumping rate constant, and partially a result of the design and construction of the system. Small increase of sewage elevation in the wet well of the pumping station results in storage of a relatively large volume, not only in the wet well itself, but in the influent chamber preceding it, and in the 84-inch Main Trunk and the 48-inch South River Interceptor.

The average feed of chlorine over the year was 54 ppm, requiring 16,400 pounds of chlorine per day. Variations of chlorine demand from day to day, and even from hour to hour, are extremely wide and sometimes quite sudden, so that control of the chlorination requires more attention, checking, and adjustment than is necessary in the greater majority of plants.

The residual chlorine in the effluent has consistently been in excess of the 0.5 ppm value required by the regulatory agencies. This is due to the fact that the specified 0.5 ppm really represents a minimum figure, so average figures naturally exceed it.

The bacterial quality of the effluent has consistently complied with the requirement of the N. J. State Department of Health, in that at least 80 percent of the samples tested shall show a coliform density of 0.2 coliform organisms or less per milliliter. During the greater part of the year, the established chlorination procedure resulted in over 90 percent of the samples being under the specified coliform density. It would therefore be possible to reduce chlorination slightly and still meet standards. However, the amount of chlorine which could be saved in this way is insignificant and it is considered preferable to maintain a margin of safety.

Average BOD removal is 19 percent, with figures for individual months ranging from 12 to 34 percent. An unusually large proportion of the BOD in the combined flow is in the soluble fraction, owing to its origin in the various industrial contributions to the system. The plant was designed on this basis, and high BOD removals were not anticipated. Pre-design studies indicated that the

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receiving water, Raritan Bay, was capable of absorbing the anticipated BOD load without affecting its quality. The data accumulated from bay samples since the system has been operating confirm this conclusion.

The removal of suspended solids has uniformly exceeded the requirements of the regulatory agencies, which specify 60 percent reduction. There is a general tendency for removals to be slightly higher in warm weather than during the cold months. A consistently high degree of removal of settleable solids has also been realized.

The average quantity of sludge barged to sea was 18,989 wet tons per month, with an average concentration of 4.8 percent solids.

Traffic Deaths and Injuries

There were 900 more deaths and more than 50,000 additional injuries on U. S. highways in 1959 than in 1958, according to statistics compiled by The Travelers Insurance Companies. Fatalities climbed to 37,600 and more than 2,870,000 were injured as a result of automobile accidents.

PROGRESS of the St. Louis Sewer District

IN RESIGNING as Executive Director of the Metropolitan St. Louis Sewer District to return to the Public Health Service, William Q. Kehr, summarized the progress of the work accomplished during the past 4½ years. Some of the more important achievements were reported by Mr. Kehr as follows: 1) Establishment of standard criteria for the design of sanitary and storm water facilities; 2) development of a uniform plan review of both private and public sewage and drainage works within the District to insure conformity with overall master plans for comprehensive sewage and drainage systems to serve the area; and of uniform construction standards to insure all sewage and drainage works are built to the same standards of high quality for dependable service and lower future maintenance costs; and 3) organization of a centralized engineering inspection department which inspects all sewer and drainage construction, whether public or private.

These are fundamental to the building of adequate, properly constructed sewers. Only in a truly metropolitan district could the advantages of these uniform standards and procedures be secured.

The District, in cooperation with the County Water Company, Laclede Gas Company, Bell Telephone Company, and the County Planning and Zoning Commission, has had planographic maps prepared from aerial photographs; topographic features are to be added later. Existing maps were of questionable accuracy whereas these maps have a high degree of guaranteed accuracy and will be helpful to other agencies, subdividers, and engineers, as well as of paramount importance to the cooperating agencies.

In new sewer construction, four of the five bond issues presented for the construction of trunks have passed. The Maline Creek trunk sewer, built with a $1.7 million bond issue, will soon be completed and in operation. It is interesting to note that this sewer could not have been built by any existing agency prior to MSD. Three other major bond issue elections are planned for this year or next, Coldwater, Gravois and Wellston. In addition to these

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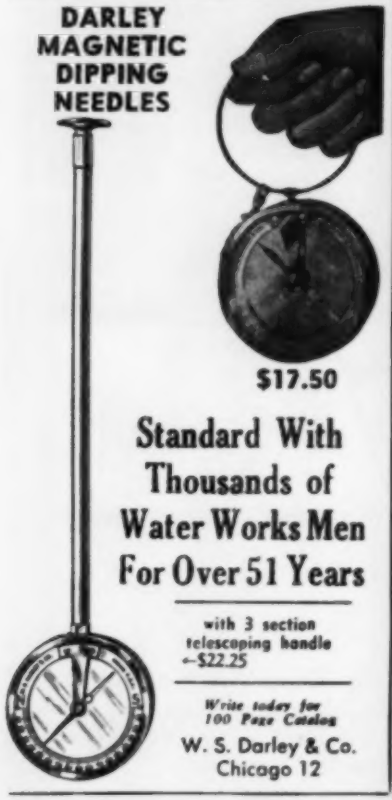

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bond issue projects, the District has created over 100 lateral tax bill subdistricts.

With the approval of the proposed bond issues and construction of these facilities, the sanitary sewer construction program—the first major goal of the District—will be completed. In the meantime, engineering has started on two other major programs. One, the $285,000 pollution abatement study which will recommend a program for the treatment of all District sewage and industrial wastes, has been underway for more than a year. This study will be completed in July 1961.

The other major program under engineering study would provide adequate storm drainage facilities for the area. Ten major storm water subdistricts and several smaller subdistricts have been proposed so far. Except for completion of engineering studies in progress, further activity in this program has been postponed temporarily pending appointment of a storm water citizens committee to investigate possible alternate methods of financing. The groundwork for this committee has been laid and the Board should proceed with the appointments.

It will be recalled that less than three months after I was appointed Executive Director, the District grew from a "paper" organization of less than 25 employees to a major, full-grown utility. In fact, the final decision to assume full operating responsibility for the vast scattered system and facilities was made less than a month and a half prior to January 1, 1956, the target date. With less than two months' operating funds on hand, we did not have money to buy the equipment, trucks or property necessary to operate. We had barely enough to pay wages until revenues were received from a service charge which would not go into effect until January 1, 1956.

Through the fine cooperation of the 85 municipalities and sewer districts in MSD, we were able to borrow or lease vitally needed equipment, rent maintenance headquarters, buy the trucks and equipment we needed and assume responsibility overnight, without a hitch, on January 1, 1956. In the meantime, it had become evident that we could save $100,000 annually by handling our own billing and collecting instead of contracting with existing agencies for this service. With over 290,000 customers to bill twice a year we could never have made the deadline if it had not been for the complete cooperation of and the countless

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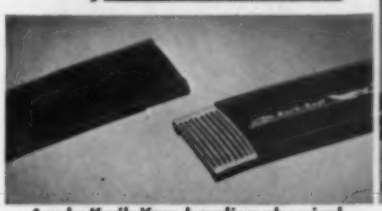

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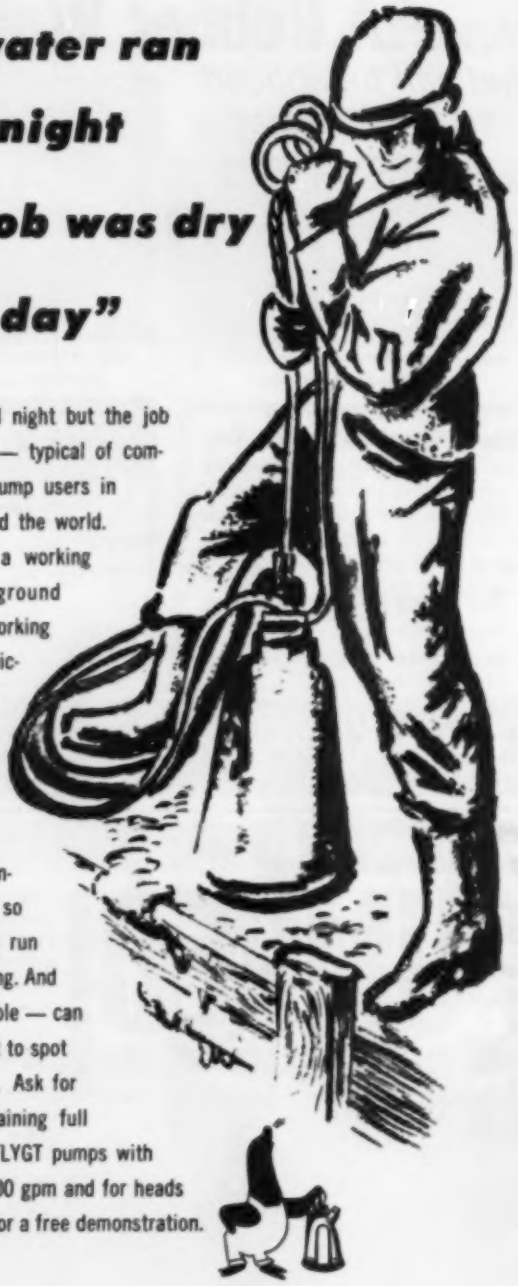

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extra hours put in by a loyal staff. The Board of Trustees did its full share by calling frequent meetings and backing me to the fullest. It was the greatest voluntary joint cooperative effort I have ever witnessed.

During the succeeding four years we have made great progress with one of the lowest sewer service charges in the nation. We now have a large fleet of modern trucks and other equipment to replace the old equipment we originally started with (the newest piece of equipment we inherited was over five years old and some went back to the late 30's and early 40's). Our emergency crews are equipped with 2-way radio for prompt dispatching. Our sewer cleaning equipment is the very latest, power-driven models. We own (with the exception of Central West Maintenance which we still rent, and North West Maintenance which we are now developing) all the various maintenance headquarters. These facilities have been paid for as they were acquired. We have continuously been on a pay-as-you-go basis and have never had to borrow against anticipated revenue for operating expenses. This in spite of the fact that in recent years we have had to contract with outside firms for many major emergency repairs to our facilities which our crews were not equipped to make.

Other activities in which we are making progress include the downspout program which is removing storm drainage from over-charged sanitary sewers; deferred maintenance problems; establishment of a cooperative rain gauging program to provide essential run-off data; microfilming many of our records to reduce space requirements; and conversion of several of our small sewage treatment plants to a more efficient process. We had hoped that we could greatly expand the deferred maintenance program and make a start towards implementing the program for providing treatment for all District wastes during the coming year. Anticipated revenues will not permit us to undertake these needed activities at this time.

STORM WATER PUMPING STATION

A PUMPING STATION and sanitary and storm sewers are under construction in East St. Louis, Ill., to accommodate drainage from

low underpasses being constructed as part of the new Interstate Highway system in East St. Louis. The station was required since a natural gradient is not available for discharge of storm water from the highway.

The contract for the work was awarded to the Fruin-Colnon Contracting Company of St. Louis, on their low bids totaling about $1,927,000. The pumping station, 20 by 100 ft., will house six 15,000 gpm. pumps. Most of the 70-foot-high housing actually will be below ground—55 feet of it. Because of this depth the base is 23 feet below the water table, necessitating a large dewatering installation, including six deep well turbine pumps. To permit construction below the water table a steel sheet pile cofferdam 23 ft. deep was installed. The open cut was 32 ft. deep. The sheet piling cofferdam was braced by reinforced concrete walers and steel beam struts to withstand the outside pressure. The open cut to water table required 30,000 cubic yards of excavation, and the cofferdam an additional 4000 cubic yards.

The sewer work included laying 4000 feet of 72-inch concrete pipe and 8000 feet of 21 to 42-in. sanitary sewer. About 1100 feet of the 72-inch pipe was tunnelled under five railroads. The tunnel had to be dewatered by a series of six deep well turbine pumps installed 100 feet deep along the line of the tunnel. They pumped up to 9000 gpm. into the 72-inch sewer line which was completed first. Mining is performed under the protection of a twelve-foot-long hydraulically operated shield which covers the top half of the tunnel. Full circle liner plates are erected under the tail of the shield.

● **SHEET PILING and steel rings brace construction shaft of this storm water pumping station being built to handle drainage from Interstate Highway structures.**

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THE INDUSTRIAL WASTE DIGEST

Prepared by **CLAYTON H. BILLINGS,** *Associate Editor*

Nitrogen Oxide in Engine Exhaust

Less than 1 ppm of nitrogen dioxide mixed with oxidized gasoline fractions and ozone in sunlight, can form irritating atmospheric pollutants. Both Otto and Diesel cycle engines produce exhaust gases containing 1,000 to 2,000 ppm of nitrogen oxide. An investigation was made of the formation of nitric oxide in the complex flame following autoignition of liquid fuel to find a means of suppressing air pollution from this source. Differences were noted in nitric oxide formation from various fuels and these were attributed to ignition lag. By using a high air temperature in the experimental apparatus before fuel injection, the ignition lag was shortened and the duration of the combustion process could be controlled. Because of the dependence of the nitric oxide formation rate on temperature and exponentially so, the maximum temperature is probably the most important factor to be considered in studies of nitric oxide abatement.

"Nitrogen Oxide Formation in Autoignition of Liquid Fuel Sprays." By George J. Mullaney, General Electric Co. *Industrial and Engineering Chemistry*, June, 1960.

Acid Mine Drainage

Controlling strip mine drainage in Indiana was started thirty years ago voluntarily by progressive mine owners. A state-wide control program was undertaken by the State Board of Health and Public Health Service in the thirties, and in the late forties a cooperative program was commenced with entry into the picture of the Indiana Stream Pollution Control Board and the Indiana Coal Association. Since treatment is not feasible, the problem is resolved into preventing the formation of pollutional substances or abating the discharge to streams. Sulfur bearing refuse from coal recovery reacts with water and air to form an acid and other undesirable end products. It is often possible to isolate sulfuritic material from either air or

Plastic Sewer Pipe Used in Difficult Project

IN ONE SECTION of Little Rock, Arkansas, the earth moved in such a manner that sanitary sewer lines in the vicinity were disrupted. When, by necessity, the lines were dug up, piping was found to be displaced and forced out of line for the entire sewer diameter. Flow had stopped, gummy soil had prevented dissipation and leeching so backflow forced seepage to overflow from the nearest manhole.

Because the soil was gummy, wet, and unstable, the trench for laying a new pipe had to be dug wider than normal — even wider than sound construction practice would dictate. Depth of the trench varied from five to eight ft. A 6-in. bed of crushed rock chips was placed in the ditch and graded as closely as possible. Thirty-ft. lengths of 8-in. Evanite plastic sewer pipe were lowered into the ditch as needed, and solvent-welded in the ditch. In some cases wet trench conditions were encountered but this did not delay the jointing procedure. After the pipe was installed, back-fill was placed around the pipe and to a depth of 18 ins. above the pipe and air tamped. The rest of the back-fill was placed in the ditch mechanically. Inspection showed no apparent infiltration.

● **30-FOOT lengths of plastic sewer pipe, 8 inches in diameter, were laid in trench and solvent-welded in place.**

At an inspection, about five months after installation, an 8-in. Sidu ball was run through this line to see whether or not the pipe had deformed out of round. At this time, a 7½-in. Flexible auger was pushed through the pipe section with no difficulty. It was evident that the pipe had not gotten out of round nor deformed. The Little Rock plastic sewer main installation is an example of successful municipal sewer main using plastic pipe. The solvent-welded joints reduce infiltration, exfiltration, and root penetration. The plastic sewer pipe is also impervious to chemicals commonly found in sewage and industrial wastes.

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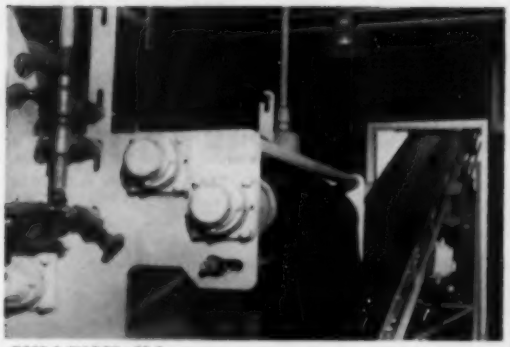

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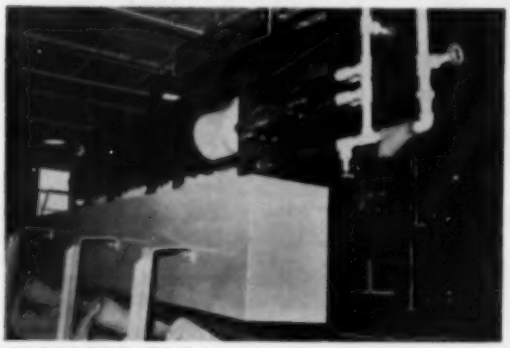

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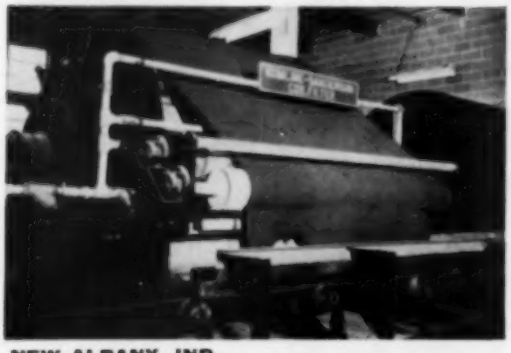

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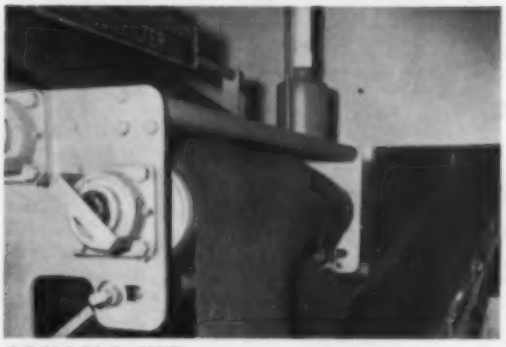

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water or both. Surface water should be excluded from pits by construction of diversion ditches and the pits should be kept dry. The sulfuritic material should be segregated and buried under clean spoil. In closing a mine the final cut can be flooded or if this is not feasible, the final cut should be graded with all refuse covered with dirt. The use of the sulfur-bearing refuse for road construction, thus creating an environment for acid formation in run-off waters, is one of the largest sources of pollution from mine drainage in Indiana. Consequently such practice has been discouraged. Experience has shown that these control measures have been effective.

"Mine Drainage Control in Indiana." By O. H. Hert, Sanitary Engineer, Indiana State Board of Health. *Journal Water Pollution Control Federation*, May, 1960.

Income Tax and Waste Treatment

The Internal Revenue Code allows a deduction from gross income for expenses incurred in carrying on a trade or business. While this seems to mean that the capital expenditure for an industrial waste treatment plant is immediately deductible, the Federal Income Tax Regulations explain that an industry cannot deduct certain expenditures for equipment and property having more than a year of useful life. Recently a Federal District Court in Pennsylvania concluded that the Woolrich Woolen Mills was entitled to deduct immediately $108,000 spent for a waste treatment plant, which the firm was ordered to provide by the State. However, other courts have held that such expenditures must be capitalized and deducted as depreciation. In following the latter procedure, an industry will find it advantageous to lease the property for the plant site rather than purchase it, making it possible to deduct the rent. The useful life of the equipment and constructed works must be determined as well as the salvage value after the expiration of the period of useful life. This year a bill, H.R. 332, was introduced in Congress by Representative John W. Byrnes of Wisconsin which would allow an accelerated amortization period of 60 months of the cost of treatment works for abatement of pollution, provided such works were constructed or acquired because of the requirements of state law. It is unlikely, however, that the bill will be enacted.

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cover Investments in Wastes Treatment Plants." By William F. Saunders, Dunnington, Bartholomew and Miller, Counsel to National Council for Stream Improvement, Inc. *Wastes Engineering*, May, 1960.

Reactor Wastes

Fuel elements used in nuclear power plants must be removed from a reactor before all the fissionable material is consumed, and are processed chemically to recover the fissionable material for refabrication and reuse. This produces a liquid waste which has a high acid concentration, high salt content and a significant radiation hazard. The wastes are now stored at great expense and there is some question about the ability of the storage vessels to withstand deterioration for the long period required for decay of the radioactive elements. The author has reported on an extension of earlier studies on proposed separation of the more critical radionuclides to permit short-term storage of the bulk of the waste. For the purpose of the study a simulated acid aluminum nitrate fuel processing waste was used. By combining cocrystallization, coprecipitation and liquid-liquid extraction, the cesium and strontium activities can be segregated from the other fission products on potassium alum and barium sulfate. Rare earths can be removed into diluted tributyl phosphate. The physical segregation of the hazardous and long-lived strontium and cesium from the other radionuclides produces at least a ten-fold decrease in storage time of the remainder, provided that the dilution factor will remove the significant concentration of the strontium and cesium radionuclides.

"Laboratory Studies of Removal and Segregation of Fission Products from Reactor Waste." By H. L. Krieger, A. S. Goldin and C. P. Straub, R. A. Taft Sanitary Engineering Center. *Journal Water Pollution Control Federation*, May, 1960.

Air Pollution Abatement Progress

A study of the comparative mortality of the causes of death in the metropolitan areas of the United States has failed to establish a disease entity for which air pollution could be cited as the sole cause. However, there is room for speculation that air pollution is contributory to carcinogenic effects, pulmonary diseases and chronic degenera-

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tive diseases. In Great Britain it is specifically associated with chronic bronchitis. The results obtained by the National Air Sampling Network from sampling atmospheric particulate matter during 1953 to 1957 indicate a geometric mean concentration in urban areas roughly six times that in non-urban areas. In terms of settleable dust, sampling over the years from several large cities shows that control measures have been effective but the curves have leveled off indicating limits of practicability and economics of further removal. The organic fraction in the collected particulate matter is a constant 7 percent for all categories of stations. There is, however, a wide variation in relative concentrations of a carcinogen, benzo (a) pyrene, for nine cities. The significance of the data lies in the trend toward increased urbanization of the country and industrialization required for improved living standards. Much less work has been done on general monitoring for gases and vapors on a national scale. Sulfur dioxide has been a universal major contributor to air pollution, and there is no promise of its decreasing in significance in spite of conversion of residential heating units to the use of other fuels than coal. The downgrading in coal quality is responsible. The ultimate solution rests with development of an economical means for sulfur dioxide removal from flue gases. Hydrocarbons in general, and more particularly the olefins and nitrogen oxides are major suspects in the Los Angeles type smog.

"Some Ramifications of Air Contamination." By John H. Ludwig, Robert A. Taft Sanitary Engineering Center. *Public Health Reports*, May, 1960.

Other Articles

"Spent **Plating Wastes** Affect Sludge Index." Copper cyanide was responsible for upsetting the Grand Rapids, Mich., activated sludge plant. Waste Engineering, May, 1960.

"Industry and **Water Resources.**" By N. D. Griswold, Dow Chemical Co., Freeport, Texas. The place of industry's water use and waste disposal in the overall national water resources picture is discussed. Journal Water Pollution Control Federation, May, 1960.

• • •

Highway Research Over Next Four or Five Years

An expanded national program of highway research, extending over the next four or five years at an

Time makes all things worse.
Demetrius

Now, there's a switch on one of our pet proverbs. Don't agree with it, entirely. Seems a pretty gloomy way of looking at things. Still, there must be some truth in it. The fellow who said it first lived over two thousand years ago . . . so it would seem that quite a few people down the centuries considered his thought worth repeating.

It's certainly true that time takes a lot out of roads. You can't build 'em and leave 'em. But the job of keeping them up isn't really so tough when you've got Calcium Chloride working for you. I haven't met many road men who didn't put chloride high up on their list of helpers. Its uses go all the way from dustlaying on rural roads to concrete strengthening and shoulder stabilization on turnpikes. And the thing that never ceases to amaze me is that new and better ways of handling chloride are constantly coming up . . . even after all its years in general use. I look forward to sharing some of them with you, through this column.

For helpful facts on how chloride can help you solve your road problems, write us for your free copy of: "The WHY of Wyandotte Calcium Chloride for Roads." *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*

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estimated cost of $34 million, was recommended in a special report to the Highway Research Board, a unit of the National Academy of Sciences National Research Council. The report said that "a wider and deeper knowledge in every field of highway transportation is indispensable," and defined 19 broad areas of research, each of which "is adjudged to rate A-1 in importance and urgency."

Range of Costs

Recommended research costs range from $50,000 for studies of "Standards for Secondary and Rural Roads" up to $10 million for "Improvement of Knowledge of Aggregates and Soils," which the report said is "most urgent because of the accelerating demand for roadbuilding materials and the diminishing supply of aggregates."

The report, based on a two-year study by a five-man technical committee, suggested in connection with the research on soils that "possibly nuclear energy may transform clays and other now undesirable materials into useful aggregates." Among other high-priority investigations urged by the committee were projects in traffic safety, road maintenance, and the use of electronic devices in simulating traffic flow, controlling vehicles on the road and simulating driver reactions.

The Special Committee was created by the Executive Committee of the Highway Research Board in June, 1958, "to screen all available research data, set priorities and estimate costs to get a program of highway research into motion as quickly as possible."

Chairman of the group is E. H. Holmes, Assistant Commissioner for Research of the U. S. Bureau of Public Roads. Other members are Harmer E. Davis, Director, Institute of Transportation and Traffic Engineering, University of California; W. A. Bugge, Director of Highways, State of Washington; F. V. Reagel, Engineer of Materials and Tests, Missouri Highway Department; and Otto H. Fritzsche, State Highway Engineer of New Jersey. Mr. Fritzsche was appointed last February to replace Charles M. Noble, formerly Director of Highways in Ohio.

The committee's report said that expanded research in this field has become critically urgent because highway transportation in the United States "has become more than a factor in the economy; it has become a part of the American way of life. The economic structure is utterly dependent on it."

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WHEN LATE, unusually severe snowstorms struck most parts of the United States during the first half of March, heavy duty machinery was called on to work round the clock to cope with the heavy snowfalls. In many instances, from Kansas through Kentucky and the southern states up into the New England states, snow removal was a full time job for days on end. Fresh snows piled up as quickly as traffic lanes were opened. Isolated rural families and even entire communities in some remote regions were completely cut off from the outside world and had to be dug out.

Strong winds and drifting snowbanks complicated the work. Drifts in many parts of the New England states reached depths of eight feet and five foot drifts were common. In New York City, Boston, Baltimore, Washington, D. C., and other eastern seaboard cities, snowfalls ranging up to 14 inches sent workers home early, stalled highway traffic and cancelled airline flights as airport runways were choked with snow.

Costs of the mammoth snow removal job ran far over budgeted funds in most areas. But, in some communities, civic leaders paused to compare current costs with 30 years ago. One of these was Manor Township, Lancaster County, Pennsylvania, where Martin E. Greider, secretary-treasurer of the Manor Twp. Road District, estimated that for each $2,000 spent now on snow removal, $5,000 was spent in 1930. He attributed the 60% reduction to the ability of a smaller work force to accomplish more work today through mechanization. For other communities, though, costs ran two and three times what had been set aside in the budget.

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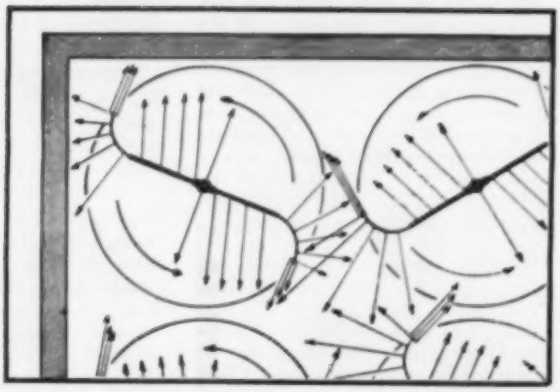

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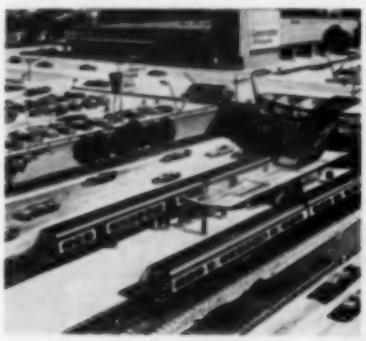
FILMS in Brief

Listed below are motion picture films of current interest to engineers, administrators and supervisors in the public works field. The companies providing these films have indicated that the films are available for appropriate use by PUBLIC WORKS readers. Requests for films should be made direct to the company listed with the film.

"Highway Hearing." The public's role in highway progress. (29 min., color, sound, 16 mm.) The Dow Chemical Company, in care of Modern Talking Picture Service, Inc., 3 East 54th Street, New York 22, N. Y.

"Everyone's Express." The commutation headache, developing in many metropolitan areas, is given a constructive twist in this new ten-minute film editorial. The film portrays the advantages of planning the coordination of several types of transportation media as opposed to relying on an automobile-dominant system. Examples are given on how some cities are making this a reality.



The 16-mm. sound film may be borrowed or bought by contacting any General Electric Apparatus Sales Office or by writing General Electric's News Bureau, Schenectady 5, N. Y.

"The Long Street." New superhighway construction and its effect on small-town businessman. (30 min., color, sound, 16 mm.) Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.

"Out of Darkness." A city's fight for better lighting. General Electric Company, Street and Highway Safety Lighting Bureau, 55 Public Square, Cleveland 13, Ohio.

"Let There Be Light." An average citizen copes with problem of inadequate street lighting. (18 min., color, sound, 16 mm.) Line Material Company, Milwaukee 1, Wis.

"Pipe Dream Come True." History of man's fight to control water. (18 min., color, sound, 16 mm.) Orangeburg Manufacturing Co., 375 Park Avenue, New York 22, N. Y.

"Water Bill U. S. A." Importance of water and what must be done to

assure plentiful supply for the future. (27 min., color, sound, 16 mm.) Caterpillar Tractor Co., News Service, Peoria, Ill.

"The EimcoBelt Story." Operation of continuous belt drum filter. (Color, Sound, 16 mm.) Eimco Corp., Audio-Visual Dept., Box 300, Salt Lake City 10, Utah.

"Sewage Lift Stations." Manufacture and installation of a factory-built sewage pump station. (21 min., color, sound, 16 mm.) Smith & Loveless Div.-Union Tank Car Co., Lenexa, Kansas.

"Quality Concrete with Calcium Chloride." Proper procedures for using calcium chloride in concrete. (12 min., color, sound, 16 mm.) Highway and Construction Materials Department, The Dow Chemical Company, Midland, Michigan.

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  Delta-Ject pneumatic ejector stations are setting new standards. Names of municipal and industrial users furnished on request. Let Tex-Vit help with all your sewage lift problems. Tex-Vit also manufactures Ellipto-Ject, a simplex station incorporating the same advanced design principles as the Delta-Ject. Other Tex-Vit products include pneumatic ejectors and packaged pump stations.

Write for Bulletin No. DJ-60

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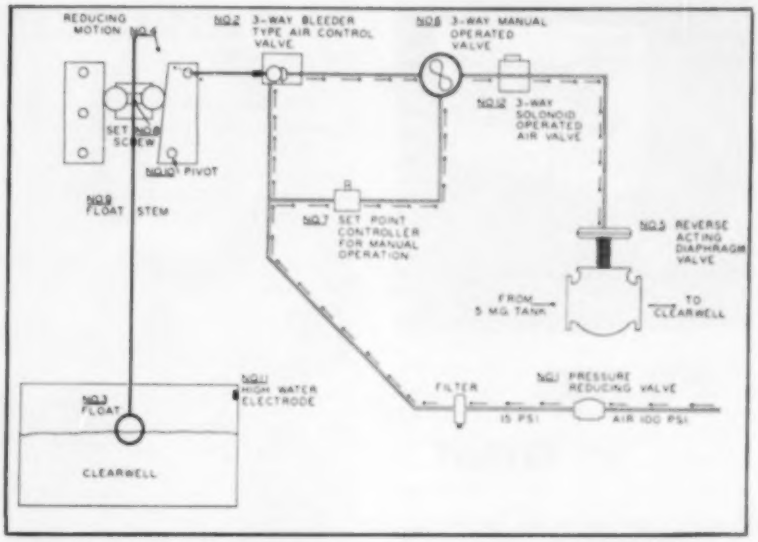
CLEARWELL LEVEL CONTROL

A MAJOR improvement during the past year at the Fort Lauderdale, Fla., water filtration plants was the installation of an automatic system, designed by C. S. McKinney, Director of Utilities. This automatically maintains a constant minimum level in the clearwell, regardless of variable high service demand. This was accomplished by supplying water to the clearwell from 5,000,000-gallon, ground-level treated water storage tanks installed at each plant several years ago. When high service pumpage exceeds the filtration rate and the water level in the clearwell falls below a predetermined level, the control allows water from the ground storage tank to flow into the clearwell as shown in the diagrammatic sketch of this control. The operations is as follows: Compressed air from the plant air system is reduced from 100 psi to 15 psi in the reducing valve (No. 1) and then supplied to the 3-way



bleeder-type air control valve (No. 2). This valve, actuated by a float (No. 3) in the clearwell, operates a unique reducing mechanism (No. 4) that reduces a 6-inch float travel to a ⅛-inch travel of the air control valve (No. 2). Valve No. 2 sends a pneumatic signal to a reverse acting diaphragm-operated valve (No. 5) which allows treated water to flow from the 5,000,000-gallon reservoir to the clearwell in sufficient quantity to maintain a constant level in the clearwell.

The operator may change from automatic to manual control by rotating the 3-way manually operated valve (No. 6) and adjusting the set point indicator (No. 7) for the desired flow. The high-level electrode (No. 11) automatically cuts power from the solenoid (No. 12) when

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water reaches the electrode. This results in the closing of valve No. 5 when a siren sounds, warning the operator of a high clearwell level.

The unusual float-operated reducing mechanism was also designed by Mr. McKinney. This 6-inch float travel reduction to ⅛-inch air valve travel completely eliminates "hunting" and results in a smooth feeder flow with close maintenance of clearwell level. By-pass needle valves in the air lines, volume air storage tanks, or dash-pot dampeners are not required.

Ball bearing rollers are attached to the float valve stem by means of a set screw (No. 8). Loosening the set screw and sliding the float stem up or down varies the clearwell level setting. Any amount of reduced motion can be obtained by changing the angle of the pivoted lever arm No. 10).

• • •

Residential Paving

(*Continued from page* 119)

and the wet mixing operation should be completed within a two-hour period, bringing to six hours the time used thus far in the daily operation.

Compaction of the prepared mixture must be accomplished in less than two hours time after attainment of optimum moisture condition in the wet mix. Primary compaction is reached by the use of a tamping, or sheepsfoot roller, followed by a tractor-drawn weeder or spiketooth harrow. When the tamping roller "walks out" of the compacted material, leaving about an inch of loose material, the primary compaction is complete. Secondary compaction is obtained by the use of a pneumatic-tired roller, capable of developing a compression of not less than 225 pounds per inch width of tire tread. After the water distributor makes a light pass over the processing area to replace water lost through evaporation, the pneumatic-tired roller operates over the entire area with a lapping action to secure uniform surface compaction.

The motor grader returns to perform final cutting and shaping to achieve a proper base cross section and a three wheel flat roller is used to leave the base in a perfectly smooth condition. Excepting the curing operation, the soil cement base processing should then be complete within an eight hour working period.

Curing takes place in the seven days following processing. A bitumen of grade MC-O is applied at the rate of two-tenths gallons per square yard immediately following completion of the base, or at latest, the next morning, to serve as curing protection and as prime coat for later application of the bituminous surface course. The base is then barricaded until curing is complete. At the end of the seven day period, faulty spots, most often found adjacent to concrete headers or drainage inlets, and material covering manholes, lampholes, water and gas boxes is removed. Castings for these are adjusted to finished grade, all base openings are filled with concrete finished to grade, concrete replacement areas are spot-primed and the soil cement base is ready for the 1 to 1½-in. bituminous surface which will complete the roadway.

Checking the Operations

The City Engineering Department provides stakes throughout the project for locations and grades for the various phases of the work and inspects the operations and materials. Following the curing of the soil cement base, the entire processing area is tested by the engineer for faulty base to be removed and

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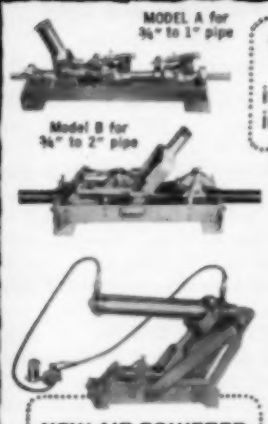

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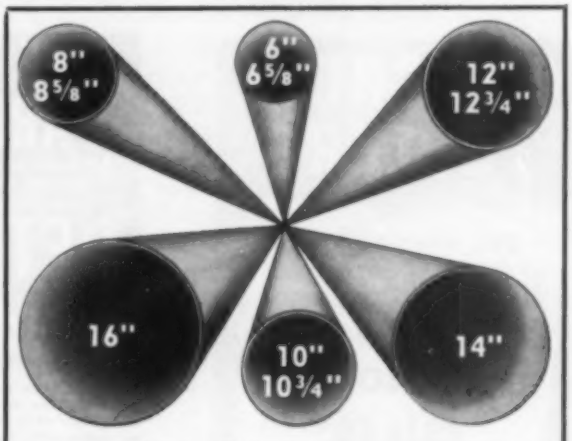

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replaced with concrete. This testing is performed by dropping a pick, head first, from a height of 4 to 6 inches. When the pick strikes the pavement with a ringing sound the soil cement base is good. When a dull thud results, the base must be removed and replaced with concrete.

After the first payment to the contractor is authorized by the City Council, a Certificate of First Voucher is filed in the County Court. At this time, notices are sent to the property owners from the Collector of Special Assessments showing the total assessment, the first installment, the second to tenth installments, and last date of making payment in full to avoid interest charges. Interest charges start to accumulate thirty days after the date of this notice at the rate of 4 percent on the unpaid balance of the assessment. During the progress of the construction, at intervals determined by the amount of work completed, payment installments are made to the contractor after being approved by the City Council. Upon completion of the project, a final inspection is made and the remaining money due the contractor is paid in full after being approved by the City Council. A Certificate of Acceptance and Completion is filed in County Court notice of which is published twice in a local newspaper not less than fifteen nor more than thirty days before the date of a hearing. After being approved in County Court, the project is officially completed and accepted.

• • •

Pesticides and Lake Rehabilitation

(*Continued from page* 98)

thusiasts of all types, and its shoreline is used by thousands of people for bicycling, tennis playing and picnicking. The shoreline contains an aqua theater and a bird sanctuary. Natural lake inflows and outflows have been altered by the construction of sewers in the area and the lake was lowered 7 feet to obtain more shoreline for recreation. In 1958, because of alleged sewage pollution, the bathing usage dropped about 68 percent.

Green Lake has a surface area of 272 acres, an average depth of about 11 feet and its bottom sediments (largely organic) exceed the volume of the overlying water.

At the request of the City of Seattle, the University is studying the Lake and its environment for the purpose of making recommen-

(*Turn to page* 186)

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PROMINENT SPEAKERS

New York City's Mayor Robert F. Wagner will welcome APWA delegates and their guests to New York City. The Hon. Robert Moses, long-time construction coordinator of New York City, will deliver the banquet address. Many other prominent public works officials will be participating in the technical sessions, including Mr. John Kenneth Galbraith, Professor of Economics, Harvard University, and author of "The Affluent Society," and Mr. A. Bjorkman, director of public cleansing, Stockholm, Sweden.

SPECIAL EVENTS

While the Congress and Equipment Show will be the heart of the meeting, the Conference will not be without its lighter side. Among the special events being planned are a get-acquainted boat ride around Manhattan Island, entertainment such as Guy Lombardo and his Nautical Musical Comedy "Hit the Deck", a fashion show and other special attractions for the ladies, prizes, a banquet, and an opportunity to tour fabulous New York.

EQUIPMENT SHOW

Ultra-modern and air conditioned, New York's Coliseum, on Columbus Circle, provides an ideal market place for displaying and viewing public works equipment. Over one hundred and twenty-five manufacturers have reserved exhibit space, making this the largest and most diversified equipment show yet sponsored by APWA. It is a unique opportunity to compare relative merits of equipment and supplies continually being developed to increase efficiency and reduce costs of governmental operations.

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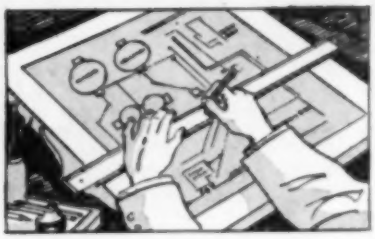

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With regard to correcting the lake water quality by treatment the following are being considered: 1) Treatment of lake water to provide a transitory or a lasting benefit; 2) water quality improvement necessary to make lake suitable for swimming, fish life and aesthetic enjoyment; 3) practicability of copper sulfate or other algicide treatments; 4) whether entire lake water should be purified or only water adjacent to bathing areas and Aqua Theatre; and 5) the nature of artificial treatment of lake water necessary to make the water quality acceptable and how may this be achieved in a practicable, effective and continuous manner.

Regulation of inflow may be of help. Studies will include: 1) Desirability of discharging storm water to the lake; 2) necessity of external water addition to achieve or to maintain a desired water quality; 3) proper points of water inflow and outflow (considering windinduced currents) to achieve best possible water circulation and exchange; 4) possibility of inducing circulation in the swimming areas if not in the other areas of the lake; 5) effect the springs may have on water quality and whether they can be utilized for local water quality improvement; and 6) the most practicable method of preventing future combined sewage overflow into the lake.

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a) possibility of raising lake elevation a few feet; 5) whether artificial pools or diked-off areas in the lake is the answer to the swimming problem; 6) whether the present bathing areas should be enlarged to increase water area per bather or should additional bathing areas be developed; and 7) the most desirable shoreline locations for bathing that will more effectively take advantage of better water quality, better circulation and other improvements.

• • •

Germ-Free Diets

(*Continued from page 109*)

and then passed under the Van de Graaff electron beam. Package thickness is controlled by gauging with a roller "screed" using the sides of the trays as guides. Any package over 1 cm. in thickness is rejected before irradiation.

As a further safeguard, paper strips containing spores of *B. globigii* are placed under packages of diet during irradiation. The strips are inoculated, incubated, and checked for bacterial growth before the diet is used.

From the beginning of the studies, more than a half ton of diets has been sterilized by irradiation and fed to germfree guinea pigs and normal control animals, with somewhat smaller amounts being prepared for germfree rats. Uniform sterilization has been obtained by irradiation with doses in the range of 2 to 3 million rads.

From preliminary results to date, it appears that germfree guinea pigs fed on the radiation-sterilized diet more closely resemble the conventional species of guinea pig than those reared on other steam-sterilized diets. Since studies are necessarily long-term, further studies with additional numbers of animals will be necessary to confirm these results and more fully to evaluate the irradiated diets.

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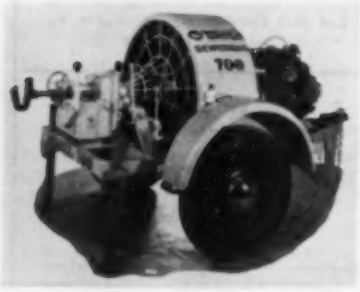

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Rockwell Manufacturing Co., Municipal and Utility Div., 400 N. Lexington Ave., Pittsburgh 8, Penna.

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Clipper Manufacturing Co., 2800 Warwick, Kansas City, Mo.

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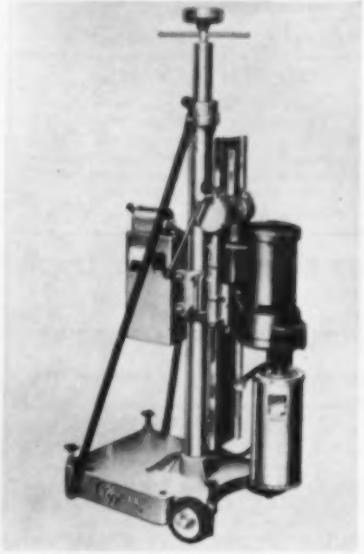

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Circle **No. 7-6** on the convenient reply card facing page 34.

Emergency Unit

This emergency lighting and power unit, which is completely automatic is designed as to permit immediate continued operation of critical lighting, PA systems, and other vital electrical equipment in case of commercial power line failure to provide 115 volt AC current. The units feature RF frequency interference suppression, instant starting, frequency stability and built-in power factor correction. They are recommended only for use with loads having power factors greater than 70 percent. To operate lower power factor loads (as low as 50 percent) additional external power factor correction is required. The ATR charger portion of these units is completely automatic and will maintain the storage battery at full charge, with minimum gassing, from regular 115—volt AC power line. All

Operated from 6 or 12-volt battery.

units are housed in attractive grey hammerloid metal cabinets. A complete range of sizes is available up to 250 watts power output.

American Television and Radio Co., 300 E. 4th St., St. Paul 1, Minn.

Circle **No. 7-7** on the convenient reply card facing page 34.

Bracket-mounted on a pole or wall by means of bolts or use of strapping.

Litter Receptacle

This mounted-type litter receptacle is formed of 16 gauge, cold-rolled steel. Designed with an eye towards beauty, the basket can be used in shopping areas as an intermediate receptacle to catch smaller litter which would not be ordinarily deposited in the large corner receptacle. 24 in. in height, 12 in. in diameter, the epoxy-coated basket with a capacity of 2400 cu. in., is mounted on bracket by means of a locking device. A special wrench loosens basket for easy emptying. Pole mounting prevents damage from kicking and falling and also conserves valuable sidewalk space.

Rodale Mfg. Co., Inc., Emmaus, Pa.

Circle **No. 7-8** on the convenient reply card facing page 34.

Bituminous Distributor

The spray bar, which is fully circulating, contains an exclusive internal distributing valve which assures an uniform spray pattern across the entire length of the spray bar. The shot meter and the bar meter eliminate the need for lengthy calculations or trials to establish the proper rate of application for each special job situation.

Features found on the Littleford Spray Master are: All operations controlled by one handwheel; shot meter to dial the rate of application from .075 to 3.0 gal. per square yard; bar meter located on operator's control panel to adjust for length of bar; torque limiter eliminates broken universal joints and shear pins; hi-low flues permit heating small quantity of material; "Uniflo" full circulating spray bar provides even starts and instant shutoff without dripping.

Littleford Bros., Inc., 457 East Pearl St., Cincinnati 2, Ohio.

Circle **No. 7-9** on the convenient reply card facing page 34.

Motor Graders

Three models of motor graders by Caterpillar Tractor Co. are No. 112F powered by a turbocharged, four cylinder diesel engine rated at 100 hp., No. 112E at 85, and No. 12E rated at 115 hp. Both the No. 112E and No. 112F incorporate oil clutch, improved blade controls, a one-piece transmission and final drive case, and dry-type air cleaner. Travel and control speeds of the No. 112F are five percent faster than those of the No. 112E. Control speeds on the No. 112E are the same as on previous models, but travel speeds are increased slightly. Positive assurance against moldboard creeping is provided by a control lock, and smooth control lever engagement results from adoption of a two-tooth jaw clutch on both the No. 112E and the No. 112F. Adjustment of the side shift rack on the No. 12E is possible through shims, which can be removed as necessary to compensate for wear. All-weather in-seat starting is provided on all three machines by a gasoline starting engine.

Caterpillar Tractor Co., Peoria, Illinois.

Circle **No.-7-10** on the convenient reply card facing page 34.

Sprinkler Pipe

The flexible pipe and quick-attach fittings used in undergound sprinkler systems, save installation time because no threading, cementing or clamps are necessary. Since all connections may be hand tightened to a positive seal, the only tool needed is a knife to cut the flexible pipe to desired lengths. Fittings may be uncoupled by hand and re-used to make easy changes in existing installations.The flexible pipe is made of DuPont Polyethylene in ⅛-in. pipe size. It cannot be damaged by freezing or attacked by corrosion and has won the approval of the National Sanitation Foundation as suitable for carrying drinking water. The flexible pipe is packaged in convenient 200 foot coils. The fittings are of polypropylene and permit a full, unrestricted water flow through the entire system. Fittings include an Adaptor assembly to connect flexible pipe to standard ¾ or 1-in. galvanized pipe; a Tee assembly and an Elbow assembly for ½ or ¾-in. riser nipples.

Rain Jet Corp., 301 South Flower St., Burbank, Calif.

Circle **No. 7-11** on the convenient reply card facing page 34.

Steel Buildings

A line of pre-engineered steel buildings of types and sizes for industry, commerce, and farming are available in clear-span widths from 5 ft. 4 in. up to 120 ft.; sidewalls up to 40 ft. In addition, there is a series of buildings with a single slope roof in widths up to 24 ft. A choice of roof slopes is offered in the self-framing and rigid-frame buildings from 8 ft. to 120 ft. wide. Another feature is a continuous beam-type purlin system in the roof of rigid-frame and truss-type buildings. Purlins are above the rafter, out of the way of wiring, sprinklers, duct-work, insulation and other equipment. A sculptured Steelox curtain-wall panel is available as the standard wall covering for truss-type and rigid-frame buildings from 32 to 120-ft. wide. Industrial interior wall panels, designed to the same 16-in. module as the exterior Steelox panels, snap into place and are moisture-proof. The panels fit all Armco buildings. Other accessories include all necessary windows, doors

Armco Drainage & Metal Products, Inc., Middletown, Ohio.

Circle **No. 7-12** on the convenient reply card facing page 34.

Street Sweeper

The Model 520 Wayne is a full 4-cu. yd. sweeper with hopper capacity fully usable. Available with single or double gutter brooms and single or dual controls, the 520 is at home on one way streets, can wheel and pivot around sharp curb returns, sweep narrow and dead end streets. Three-wheel design insures maneuverability and safety. Elevator drive chains, built around a core of high alloy steel woven cables, withstand the abrasive wear of dirt and sand. Gutter brooms are located in front of the wheels, within full view of the operator.

Other features include: Full floating pickup-broom suspension to automatically maintain sweeping pressure; clam-shell bucket action dumping, hydraulically operated; power brakes and steering.

Wayne Manufacturing Co., 1201 E. Lexington St., Pomona, Calif.

Circle **No. 7-13** on the convenient reply card facing page 34.

Tractor Attachment

Hydraulic connectors easily engaged by twisting motion.

A versatile tractor attachment, known as the Walker-Cline Sidedozer, is designed to perform work usually done by hand labor, such as cleaning or grading under highway guard rails, back-filling of shallow trenches, finish grading curb areas and trimming or grading around culverts. Average guard rail or ditch cleaning can be done at a rate of 400-600 feet per hour depending upon the quality and volume of material to be moved. The unit is tailored to fit most four-wheel tractors and the entire assembly may be attached or removed in twenty minutes in the field using only a hammer and a pair of pliers. The unit is hydraulically operated. The horizontal and vertical positions or motions are controlled by separate hand valves. The unit is suspended beneath the tractor in a manner to permit pulling or pushing the load to or away from the side of the tractor by reversing the blade. Maximum reach of the unit is approximately four feet outside the tire tread. For tractors without hydraulic equipment, a conversion kit is available.

Easley Engineering and Manufacturing Co., 2440 Goorich Avenue, Ferndale 20, Michigan.

Circle **No. 7-14** on the convenient reply card facing page 34.

Aluminum Bodies

The lower deadload permits high, profitable pay loading.

The 13-ft. aluminum dump bodies, manufactured by Hercules Steel Products Co., Galion, Ohio, permit big legal payloads and keep maintenance costs low. Aluminum side boards and cab shield add greatly to the trucks' load-carrying capacity. All units are equipped with front-mounted telescopic hoists.

Hercules Steel Products, Inc., Galion, Ohio.

Circle **No. 7-15** on the convenient reply card facing page 34.

Traffic Controllers

This complete line of vehicle-actuated traffic control equipment, features semi-vehicle-actuated and fully-vehicle-actuated controllers. All units are designed to provide a flexible traffic control system and are wired to accommodate a wide variety of accessory units. Electronic components are mounted on a hinged secondary panel which may be swung away from the face plate for servicing. Detachable wiring plug electrically connects the timer to the rear panel on which special features may be mounted. Color-coded wiring and stockinged wiring harnesses are used throughout.

Crouse-Hinds Company, Syracuse 1, N. Y.

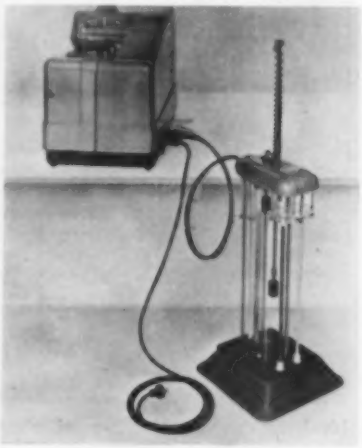
Circle **No. 7-16** on the convenient reply card facing page 34.

Tape Analyzer

An automatic instrument that detects and measures the level of impurities in fluids, the Graver Automatic Tape Analyzer, can detect coliform bacteria, algae and plankton in municipal water supplies, and potentially can be modified to detect trace quantities of pollutants and radioactivity in water and the atmosphere. All these applications derive from the instrument's basic analyzing method — the Millipore Filter test. In this test particulate material is quantitatively removed from a liquid or gaseous sample by an ultrafine Millipore Filter membrane and retained on the filter surface where it may be easily identified, sized, counted or tested. The tape analyzer automates the Millipore test by filtering samples in sequence as often as desired through a nylon-backed tape of Millipore Filter membrane and printing the time each sample is taken. The basic data produced is a circular stain or discoloration on the tape made by the solids extracted from the filtered fluid. The degree of discoloration, proportionate to the insoluble solids concentration, can be calibrated by analyzing a portion of a sample and then running another portion through the tape analyzer. A strip-chart recorder is also available. The analyzer is only slightly larger than an office adding machine and is completely portable.

Graver Water Conditioning Co., 216 West 14th St., New York 11, N. Y.

Circle **No. 7-17** on the convenient reply card facing page 34.



Industrial Tractors

Powered by a 206-cu. in engine, the big Mo 500 and Big Mo. 600 have heavy-duty axles and frame to handle highway and construction attachments including dozer blades, crane hooks, mowers, backhoes, loaders, and several types of buckets including ejector, trench bellhole, material and snow buckets. Five forward speeds on both models range from 2.63 to 14.57 mph, with the five reverse speeds ranging from 3.29 to 18.22 mph. Hydraulic power steering is standard on both models. Double constant-running, direct-coupled hydraulic pumps are mounted at the rear and operate the loader, backhoe, other attachments, and the power steering. The front-end loaders are of box-type construction and are cradle mounted. The loader has a one-lever control to raise and maintain bucket level during the lift cycle, and to adjust the bucket to dig position during the lowering cycle. On the backhoe, angle-poised, individually-controlled hydraulic outriggers give bracing and permit digging at right angles to the machine and on hillsides. The operator's seat pivots with the boom and is offset to provide a complete view of the 190° swinging boom and the work area. The loader bucket capacities are ⅝ yard on the "500" model and ¾ yard on the "600" model; lifting capacity 2000 lbs. on the "500" and 4500 lbs on the "600"; lift height 10 ft. 7 in. on the "500" and 10 ft. 10 in. on the "600".

Minneapolis - Moline Company, Hopkins, Minnesota.

Circle **No. 7-18** on the convenient reply card facing page 34.

Paint Spray

High-visibility fluorescent enamel for emergency safety marking may now be applied quickly with a convenient new-type finger-tip spray dispenser. Known as the "Jek-Pak," the aerosol sprayer consists of three elements—a can of propellent, an unbreakable plastic spray head, and a glass jar which holds the thinned "Pyralux" fluorescent enamel in any one of the Du Pont fluorescent colors.

Spray On Products Co., Cleveland, Ohio.

Circle **No. 7-19** on the convenient reply card facing page 34.

Ideal for quick stenciling of signs.

Ideally suited to mowing high weeds.

Rotary Mower

The 5-wheel riding rotary mower is powered by a 9 hp, 4-cycle engine, has variable forward speeds and reverse drive, a cutting head equipped with a heavy duty cutter bar which cuts an even 34-in. swath, and a specially designed side discharge chute to clear out cut grass and weeds, allowing the operator to maintain mowing speed in heavier growth. Special attachments available for the "Mow-Mobile 34" include: A special handle for those who prefer to walk behind the machine on hilly terrain; a close-coupled 42-in. snow blade; a leaf mulcher; special pivoting skids and replaceable skid shoes; an electric starter and generator set.

Jacobsen Manufacturing Co., 747 Washington Ave., Racine, Wisc.

Circle **No. 7-20** on the convenient reply card facing page 34.

Tack Coat Spreader

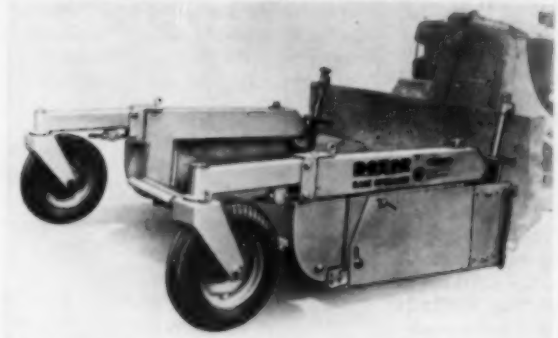
The "Tack-Coater," TC-100, deposits a smooth, even tack-coat over surfaces in preparation for laying extruded asphalt curbing. Varying widths are adjusted by turning the swivel hung spray bar to angles desired based on curb form widths to be machine laid. One man can operate the unit.

Miller Spreader Corp., 4020 Simon Road, Youngstown, Ohio.

Circle **No. 7-21** on the convenient reply card facing page 34.

Eliminates tedious hand operations.

Base Spreader



The spreader features a simplified mounting arrangement.

The Dozor base spreader with adjustable hopper and spreading width, Model 18, is designed so that one unit can be used, without modification, on any bulldozer - equipped Caterpillar machine. Cross-members can be adjusted to fit specific spreading jobs from 8 to 18 feet wide. Optional wing gate extensions at the side allow additional width, if desired. The entire spreader mounts directly on the tractor's dozer blade through the use of large threaded clamps. The dozer blade serves as a strikeoff. Depth is accurately adjustable from 1-in. to any requirement. Caster wheels are also adjustable either up or down, in or out, to fit specific job conditions. When laying base against existing slabs, one wheel can be adjusted to run on the pavement with the other on subbase. Capacity is approximately 600 yards per hour.

Ulrich Manufacturing Co., Roanoke, Ill.

Circle **No. 7-22** on the convenient reply card facing page 34.

Lift And Dump

For tree trimming and work on overhead utility lines, a combination tilt action truck body with a trimmer lift is available. This unit is mounted on any two-ton chassis of acceptable G.V.M. 19,500 lbs., 172 in W.B., 102 in. C.A. The "Trim Lift" protects the worker in the basket and the men on the ground through the use of Spiralloy, a glass filament wound epoxy structure with a dielectric strength of 50,000 volts. The unit has a Spiralloy outer boom and a Spiralloy pylon insert which prevent the truck from being energized. An additional feature is the tilt body positioned for quick dumping by a hydraulic hoist.

Asplundh Chipper Co., 501 York Rd., Jenkintown, Pa.

Circle **No. 7-23** on the convenient reply card facing page 34.

Tractor Dozer

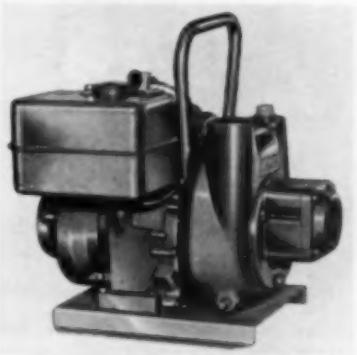
Blade is 10-ft. 3-in. wide, digging depth is 2-ft. 3-in.

This diesel powered, 162 horsepower unit, smallest in the Michigan line of rubber-tired tractor dozers, has all features standard on the two larger units of this type, including the Michigan power train. The Model 180 has a blade containing a built-in push plate that permits it to be used as a dozer or pusher without exchanging dozer blade for push block. Two double-acting hydraulic cylinders are controlled with a lever permitting the operator to tilt the blade while in motion to allow deep blade bite on hillside work.

Construction Machinery Div., Clark Equipment Co., Pipestone Rd., Benton Harbor, Mich.

Circle **No. 7-24** on the convenient reply card facing page 34.

Utility Pumps



The compact, lightweight, high capacity self-priming pump will discharge up to 7000 gal. per hour. Powered by a light-weight aluminum engine, pump can be lifted and transported by one man. All cast iron parts are protected inside and out against corrosion and abrasion by an epoxy coating. Built-in check valve holds prime. Non-clogging impeller handles water with a high percentage of solids. A quickly-removable suction plate makes it easy to inspect and clean impeller. Impeller can be replaced without removing pump case. Pumps are available in two sizes—M-5 (5000 gal. per hour with 1½" suction) and M-7 (7000 gal. per hour with 2" suction).

The F. E. Myers & Bro. Co., Ashland, Ohio.

Circle **No. 7-25** on the convenient reply card facing page 34.

Flow Tube

The "Lo-Loss" Flow Tube is a differential producer for accurate measurement of flow with lowest head loss and highest recovery. With its short compact length, installation of the flow tube can be made on horizontal, vertical or inclined lines. For use with clear water, sewage, sediment bearing liquids, trade wastes, air or gases, the flow tube is available in cast iron, bronze, stainless steel, plastic or any specified material, and can be formed, cast or fabricated to meet special requirements.

Burgess-Manning Co., Penn Instruments Div., 4110 Haverford Ave., Philadelphia 4, Pa.

Circle No. **7-26** on the convenient reply card facing page 34.

EITHER BY THE GLASSFUL, OR THE BILLIONS OF GALLONS . . .

. . . pure water is the lifeline of Municipalities and Industry.

For over 60 years, Roberts Filter Manufacturing Company has been complementing the engineering profession in supplying water purification equipment throughout the Western Hemisphere.

ROBERTS FILTER Manufacturing Company Darby, Pa.

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Public Works Congress and Equipment Show Conventioneers to your meeting at the Coliseum AUGUST 14-17, 1960

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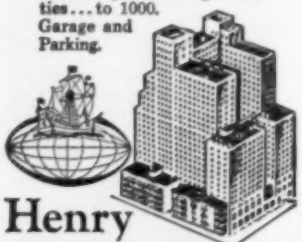
In the heart of New York City —58 steps from Coliseum. Near all activities & transportation terminals. Swimming Pool available to guests. Entertainment Nightly in Voyager Room. Superb Meeting Facilities... to 1000. Garage and Parking.



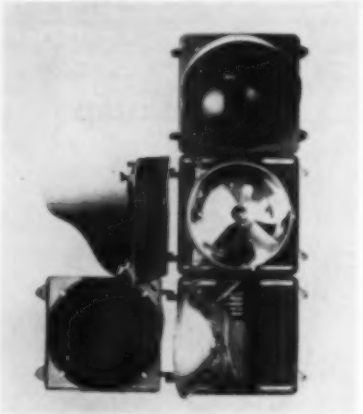
Henry Hudson Hotel

353 West 57th Street, New York 19
COlumbus 5-4000

NEW YORK CITY

Traffic Signals

The M-Series of 8-in. and 12-in. signals and beacons are adjustable and interchangeable. Adjustability is obtained through the use of Tri-Stud mountings between sections and on mounting brackets for 360° adjustability of each section or each signal head. The 8-in. and 12-in. sections are completely interchangeable and can be mixed or matched as desired. The proper pattern of the light beam with relation to on-coming traffic is controlled with the fixed focus socket. This socket allows for proper filament location without the use of tools. The filament can be accurately placed for the most efficient operation by pulling the lamp forward about ⅛ in. to disengage the teeth, turning the lamp to the desired filament placement, releasing the lamp and allowing it to lock in place.



Signal sections are interchangeable.

Some of the design features are: Door and reflector assemblies removable without tools; visor and lens removable without removing screws; positive locking fasteners; stainless steel hinge pins; and single weatherproof Neoprene gasket sealing reflector and door.

Traffic Signals, Inc., 222 Beach St., Shreveport, La.

Circle **No. 7-27** on the convenient reply card facing page 34.

Pocket Radio

An all-transistorized shirt-pocket personal radio communications receiver with miniaturized circuitry, the "Voice Director," weighs only 12 ounces with battery. Designed for indoor and outdoor voice-paging to reach key personnel, the equipment is engineered so the person wearing it may be contacted instantly by a base station transmitter, a two-way radio in a car, or by a portable unit operating on the same frequency. Initially, frequencies in the 150-174 mc. range will be used. The receiver uses a 6½ volt, single mercury battery and a ferrite loop-stick for an antenna. A convenient directive horn, clipped to the wearer's lapel, is used when privacy is not required and when loudness of the radio will not disturb others. When the person wearing the unit desires to hear to the complete exclusion of others, an ear-piece may be used. The plastic horn and ear-piece are combined for normal use and the horn quickly snaps off for ultra-private ear-piece listening. Adjustable volume and squelch controls are at the top of the unit.

Radio receiver pages key personnel.

General Electric, Communications Products Dept., Lynchburg, Virginia.

Circle **No. 7-28** on the convenient reply card facing page 34.

NEWS OF ENGINEERS

Prof. GORDON P. FISHER has been appointed Associate Dean of the College of Engineering of Cornell University, Ithaca, N. Y.

EDWARD W. TAYLOR of Charleston, S. C., who has represented the U.S. ICA in Viet-Nam for the past three years, has returned to this country on leave. He has been engaged in a broad road and bridge construction program in Viet-Nam and will return there to resume his work in the near future.

ERNEST O. LARSEN has joined the consulting firm of Berger Associates and will be located in Salt Lake City, Utah. Mr. Larsen retired from the Bureau of Reclamation recently after 37 years of service.

JOHN H. FISK of Franklin Park, N.J., has been appointed Assistant to Secretary, W. H. Wisely of the American Society of Civil Engineers. He will work mainly with student chapters.

DR. LLOYD DONNELL has been named senior research scientist of the Institute of Science and Technology, University of Michigan.

C. RICHARD TREPTOW has been appointed assistant vice-president of Engineers Incorporated, Newark, N.J.

WILLIAM Q. KEHR, for the past five years executive director of the Metropolitan St. Louis Sewer District, has resigned to take a position with the Public Health Service in Washington, D. C.

R. S. RANKIN, long-time outstanding sanitary engineer, died June 6 at Stamford, Conn. He retired from Dorr-Oliver, Inc three years ago after serving as chief sanitary engineer. He was a frequent contributor to many engineering journals and was a consultant to PUBLIC WORKS in the sanitary engineering field. Mr. Rankin attended the American Water Works Convention at Bal Harbour, but became ill shortly after his return and died after a brief illness.

• • •

Urban Public Health Seminar Scheduled

A seminar on urban public health and the residential environment is to be held August 8 to 12 at Southern Illinois University, Carbondale, Illinois. Attendance is open to all who pre-register, but the program is aimed at supervisory personnel in the public health housing, planning and urban renewal fields. The staff includes Dr. E. R. Krumbiegel, Eric Mood, Richard Daley, Dr. Claire Ryder, Donald R. Fessler and Richard Poston. The seminar is a concluding session of a 5-week course in APHA housing quality appraisal technique, but the first four weeks of the course is subject to limited registration. Sponsorship is by the Southern Illinois University, Illinois State Department of Health and Communicable Disease Center of the Public Health Service. Those interested in attending the seminar should apply to the Chief of the Training Branch, Communicable Disease Center, 50 Seventh St., N.E., Atlanta 23, Ga.

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Experienced Engineer Administrator Available

A professional engineer with heavy administrative experience desires to reassociate in a career position with broad opportunities.

Possessing impeccable references in support of his qualifications, he is an A.T.R. pilot, has a substantial background in military and civilian aviation, has a proved record of advancement in the coordination and supervision of the design and construction of major public works projects and, at the age of 41, is particularly qualified in engineering contract administration.

For complete Resume, Write to:

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PUBLIC WORKS Magazine
200 South Broad St.
Ridgewood, N. J.

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Selected, pertinent, current references in the water, sewage, industrial waste and swimming pool fields. The service includes:

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Attmore E. Griffin

24 Sunset Rd., Pompton Plains, N.J.

City Engineer Available

A highly qualified engineer who has served a city engineer for a good-sized city in the Middle West desires to relocate. Known to and recommended by the Editor of Public Works, he has had broad engineering experience, as a city engineer, in engineering practice and as an Army officer in World War II. Fuller details on training and experience on request.

Write to:

Box P-5
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200 South Broad Street
Ridgewood, New Jersey

JUNOR CIVIL ENGINEER

Applications are being accepted for a Junior Civil Engineer vacancy. Starting salary dependent on qualifications. Salary range, $493.15 to $600.00 per month. A degree in civil engineering or professional engineering experience with a municipality or allied engineering experience required.

Apply to:

Personnel Office
City Hall
Richland, Washington

WANTED

Highway Materials Research Engineer to direct expanding research program. Salary and rank will depend on qualifications. Advanced degree and professional registration desirable.

Write to:

G. A. Riedesel
Director of Industrial Research
Washington State University
Pullman, Washington

BUILDING COMMISSIONER

The City of Hamilton, Ohio, population of 73,000 is recruiting for a full time Building Commissioner. Requires Professional Engineer or Registered Architect; five years related experience in building construction and inspection. Must have supervisory ability. Age 28 to 55. Civil Service position; city offers excellent fringe benefits; salary $8000 to $9800.

For details, write to:

Harold A. Hart
Director of Civil Service
Municipal Building
Hamilton, Ohio

CIVIL ENGINEER WANTED

Registered Professional Engineer capable of performing engineering and administrative duties required of City Engineer. Salary open. Send resume of educational and work experience background and salary requirements.

Write to:

City Manager's Office
City of Marysville
Michigan

INVITATION TO BID

Sealed bids will be received at the office of the City Clerk, City Hall, Fairbanks, Alaska, until 5:00 P. M., July 18, 1960, for furnishing Garbage Disposal Service for the City of Fairbanks, Fairbanks, Alaska, and shall thereafter be publicly opened and read.

Bids shall be submitted upon the Proposal Form and all of the Contract Documents shall become a part of the Contract and Agreement between the successful Bidder and the City of Fairbanks.

The City of Fairbanks reserves the right to reject any or all bids and to waive informalities in the bidding.

SEWAGE PLANT OPERATOR

Sewage Plant Operator wanted by the City of Munising. Certified Class "C" license required. Send resume of qualifications and experience. State starting salary required and earliest starting date.

Apply to:

Walter E. Looney
City Manager
City Hall
Munising, Michigan

CIVIL ENGINEER WANTED

The City of Franklin, Milwaukee County, Wisconsin is seeking a civil engineer. Salary is open. State qualications, salary expected and full particulars.

Write to:

City of Franklin
Richard R. Eddy, City Clerk
7811 West Ryan Road
Hales Corners, Wisc.

INDEX OF ADVERTISEMENTS

Alabama Pipe Co. 180
Allis-Chalmers ..... 50 & 51
Amercoat Corporation 162
American Bitumuls & Asphalt Company 151
American Cast Iron Pipe Co. 66
American-Marietta Company 35
Concrete Products Division
American Motors Corporation 33
American Playground Device Co. 180
American Public Works Association 183
American Steel & Wire 83
Div. of United States Steel
Aqua Survey & Instrument Co. 80
Asplundh Chipper Co. 61
Ayer-McCarel Clay Co., Inc. ..... 56 & 57

Badger Meter Mfg. Company 47
Bison Aluminum Chain Co., Inc. 146
Blaw-Knox Equipment Division 42
Bluewaters Hotel 146
Bowerston Shale Co. ..... 56 & 57
Brooks Chemicals, Inc. 22
Bucyrus-Erie Company 72
Buffalo Meter Co. 81
Burgess-Manning Company 142
Penn Instruments Division
Butler Manufacturing Company 43

Cannelton Sewer Pipe Co. ..... 56 & 57
Cast Iron Pipe Research Assoc. ..... 8 & 9
Caterpillar Tractor Co. ..... 4, 29 & 84
Centrilina Corporation 141
Chain Belt Company 75
Chicago Bridge & Iron Company ..... 14 & 15
Chicago Pump Co. 3
Clark Company, H. W. 143
Clark Equipment Company 149
Construction Machinery Division
Clark-Wilcox Company 157
Classified Ads 197
Cleveland Trencher Company 163
Climax Engine Manufacturing Co. 6
Div. of Waukesha Motor Co.
Cushman Motors 175

Dailey & Co., W. S. 168
Daybrook Hydraulic Division 133
Young Spring & Wire Corp.
Dempster Brothers 128
Diamond Alkali Company 153
Dilhay Clay Mfg. Co., W. S. ..... 56 & 57
Douglas Fir Plywood Assoc. ..... 30 & 31
Dravo Corporation 28
Dratt Manufacturing Corp. ..... 20 & 21

Eaton Manufacturing Company 79
Axle Division
Enterprise Engine & Machinery Co. 12
Subsidiary of General Metals Corp.
Essick Manufacturing Company 60

Fisher Research Laboratory, Inc. 168
Fitchburg Engineering Corp. 135
Flexible, Inc. 164
Flygt Corporation 170
Ford Motor Company ..... 67 & 68
Tractor & Implement Division

Fornova Inc. 182
Foster Company, L. B. 48
Fox River Tractor Company 74
Foxboro Company 139

Galion Iron Works & Mfg. Co. ..... Second Cover
Gar Wood Industries, Inc. 131
Gates Rubber Company 169
Gates & Sons, Inc. 154
General Electric Company ..... 10 & 11
Gladhill Road Machinery Corp. 158
Good Road Machinery Corp. 157
Gorman-Rupp Company 53

Hamilton Kent Mfg. Co. 13
Henry Hudson Hotel 196
Hersey-Sparling Meter Company ..... 16 & 49
Highway Equipment Company 152
Hotel Tuller 182
Hough Company, Frank G. ..... 64 & 65
Huber-Warco Company 25

International-Harvester Company ..... 17, 20 & 21
International Salt Company 199
Iowa Valve Company 137
Irving Subway Grating Co., Inc. 177

Jaeger Machine Company 159
Johns-Manville 165
Johnson Gear & Mfg. Co., Ltd. 80

Keasbey & Mattison Company ..... 76 & 77
Kirsl, Inc. 147
Koehring ..... 36 & 37
Div. of Koehring Company
Kohler Company 200
Komline-Sanderson Engineering Corp. 173
Koppers Company 73
Tar Products Division

Lakeside Engineering Corporation 176
Lock Joint Pipe Co. ..... Third Cover

M-B Corporation ..... 156 & 159
M & H Valve & Fittings Co. 138
Massey-Ferguson Industrial Div. 32
McConnaughay Mixers, Inc. 150
Measure Rite, Incorporated 46
Morse Boulger Inc. 174
Morton Salt Company 27
Mueller Co. ..... 19 & 71
Municipal Service Company 45

Natco Corp. ..... 56 & 57
National Clay Pipe Mfrs. Inc. 23
National Rain Bird Sales & Engr. Corp. 63
Neenah Foundry Company 171
Nichols Engineering & Research Corp. 167

O'Brien Manufacturing Corp. 166

Pacific Flush Tank Co. 161
Palmer Filter Equipment Co. 178
Pfaff & Kendall 70
Pipe Linings, Inc. 54
Pomona Terra-Cotta Co. ..... 56 & 57
Preload Company 182
Public Works 176

Radiator Specialty Co. 154
Rainy Sprinkler Sales 63
Reed Manufacturing Company 18
Roberts Filter Mfg. Co. 196
Rockwell Mfg. Company ..... 39 & 59
Rockwell-Standard Corporation 69
Transmission & Axle Division—Detroit
Rohm & Hass Company 82
Rynel Corporation 38

Seaman-Gunnison 148
Division of Seaman Corp.
Schield Bantam Co. 55
Service Recorder Company 132
Smith & Loveless 61
Div.-Union Tank Car Company
SOHIO 155
Southern Pipe ..... 40 & 41
Div. of U. S. Industries
Sprague & Henwood, Inc. 147
Standard Steel Works, Inc. 44
Steel Plate Fabricators Assoc. 140
Synchro-Start Products Inc. 22

Tampo Manufacturing Co. 63
Tarrant Manufacturing Co. ..... 158 & 178
Taylor & Co., W. A. 174
Tennessee Corporation 62
Texas Vitrified Pipe Co. ..... 56 & 57
Tox-Vit Supply Company 179
Trafficaides Corporation 24
Trickling Filter Floor Institute ..... 55 & 57
Trojan Mfg. Co. 181

U.S. Rubber Reclaiming Co., Inc. 138
United States Concrete Pipe Company 26
United States Steel Corp. 83

Valley Manufacturing Co. 181
Vermeer Manufacturing Company 134
Visi-Mator, Inc. 176

Wallace & Tiernan Co., Inc. ..... Back Cover
Wanamen Pump Mfg. Co. 58
Western Machinery Company 169
Westinghouse Electric Corp. ..... 77 to 80
Weston Co., L. A. 174
Whiting, E.B. & A.C. 52
Wyandotte Chemicals 177
Michigan Alkali Division
Wilkinson Products Company 168
Wisconsin Motors Corporation 144
Wylie Manufacturing Co., Inc. 80

CONSULTING ENGINEERS APPEAR ON PAGES 184 to 189

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OCT. 25, 1955: FREEZING RAIN—CHICAGO AND DETROIT
OCT. 24, 1956: 3″ SNOW, FREEZING RAIN—SOUTH DAKOTA
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(Source: U. S. Weather Bureau Climatological Data)

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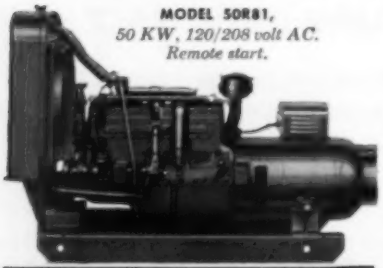

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★ Over 300 members of the **Huber-Warco** distributor organization and publication represenatives attended the "kick-off" sales meeting at Marion, Ohio, late in May. **President Jacque E. Jones** was host for the 3-day affair.

★ **E. W. Bacharach Inc.**, long in the water conditioning equipment field in Kansas City, becomes an affiliate of **J. F. Pritchard & Co.**, working with another Pritchard affiliate, Municipal Service Co. who furnish and install sewage treatment plants.

★ **Joseph F. O'Grady** has been appointed assistant vice president of the Municipal and Utility Division,

Mr. O'Grady

Mr. Hoyt

Rockwell Mfg. Co., Pittsburgh. **John G. Hoyt, Jr.**, succeeds Mr. O'Grady as product sales manager, moving from Atlanta to Pittsburgh. **Marion F. Huff** replaces Mr. Hoyt in Atlanta.

★ **Kenneth L. Lyttle** is named advertising manager, **Diamond Alkali Co.**, Cleveland.

★ **V. L. Snow** is appointed general manager, **Euclid Div. of General Motors.**

★ **William S. Lake** is appointed general sales manager, **Wayne Mfg. Co.**, Pomona, Calif. **Simon Tamny** becomes director of research and development of the same company.

★ **Glenfield & Kennedy**, makers of MICROSTRAINING equipment, move to 275 Halstead Ave., Harrison, N. Y., reports **George R. Evans**, vice president.

★ **Nichols Engineering & Research Corp.**, New York, appoints **Thomas E. Davy** manager of its Filtration Division, for both municipal and industrial waste applications.

★ **U. S. Pipe and Foundry Co.** appoints **Whitney K. Stearns**, manager of New York office; **James J. McCarthy** succeeds Mr. Stearns as Boston sales agent; **William J. Wolfersheim** replaces **Mr. McCarthy** in charge of the Detroit office. **Walter H. Swanson**, Minneapolis sales agent, died April 22.

★ **Robert Bendlin** succeeds **Myron Kitaif** as manager of **Blackburn-Smith Mfg. Co.**

★ **Thomas J. McNeill** becomes New York district manager, the **Eimco Tractor Division of the Eimco Corporation**, Salt Lake City.

★ **Arthur S. Hicks** has been named district manager for the Philadelphia area by **Centriline Corp.**, underground pipe cleaning and lining.

★ The fifth annual company dinner and fourteenth anniversary of the **Komline-Sanderson Engineering Corp.** at Peapack, N. J., brought out some 200 officers, employees and guests. **Col. W. A. Hardenbergh** of PUBLIC WORKS was guest of honor, and **Hon. Salvatore A. Bontempo,** commissioner of the New Jersey Department of Conservation and Economic Development, was guest speaker.

★ **David E. Greene** is appointed assistant to the president of **Hamilton Kent Mfg. Co.**, Kent, Ohio.

★ **Glenn R. Peterson** is named manager of marketing for General Electric Co.'s Communication Products Department, Lynchburg, Va.

★ The rural wedding had been suddenly advanced in date. "But where's the father of the bride?" inquired a guest of the nervous groom. "Who do you think that old boy over there with the shotgun is?" was the glum response, "Daniel Boone?"

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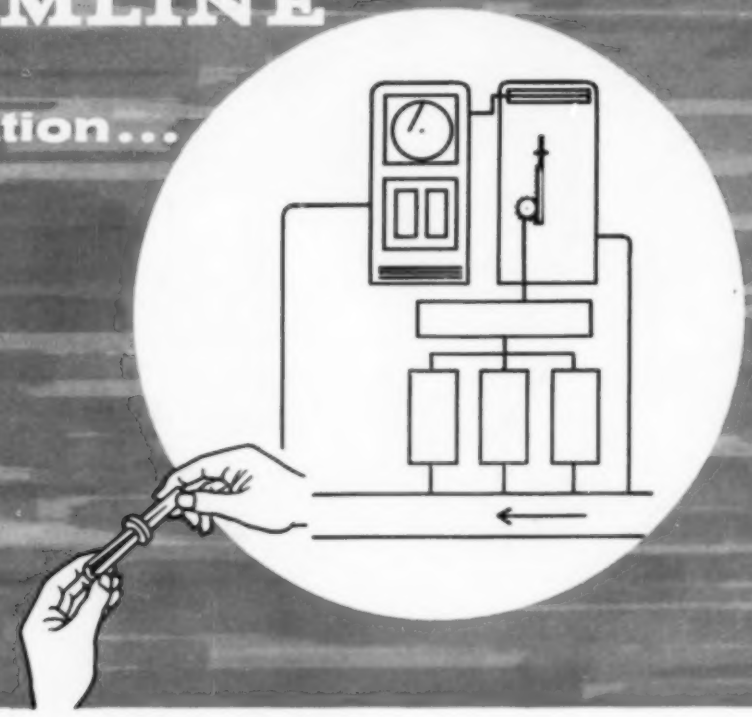

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